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Air Force



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Nuclear  
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Strategic Defense  
Initiative  
Organization

## DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

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FY 1992 SBIR SOLICITATION  
 PHASE I AWARD ABSTRACTS  
 AIR FORCE PROJECTS  
 VOLUME III

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## PREFACE

This report presents the technical abstracts of the Phase I proposals that resulted in contract awards from the Fiscal Year 1992 Solicitations of the Department of Defense (DoD) Small Business Innovation Research (SBIR) Program. The Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA)<sup>1</sup>, Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO) are the DoD components of the SBIR Program. Two solicitations inviting small business firms to submit proposals under this program were published in FY92. Navy, Air Force, DARPA<sup>1</sup>, DNA, and SDIO participated in Program Solicitation 92.1 (Closing Date: 10 January 1992), and Army, Navy, and DARPA<sup>1</sup> participated in Program Solicitation 92.2 (Closing Date: 1 July 1992). The selection of proposals for funding was made from proposals received by the Military Services and Agencies.

### FY 1992 SBIR PROGRAM

	<u>Number of Topics</u>		<u>Proposals Received</u>		<u>Phase I Awards</u>	
	<u>92.1</u>	<u>92.2</u>	<u>92.1</u>	<u>92.2</u>	<u>92.1</u>	<u>92.2</u>
Army	0	177	0	1841	0	260
Navy	106	82	1495	832	127	92
Air Force	181	--	2128	--	229	--
DARPA <sup>1</sup>	129	97	1301	911	105	77
DNA	25	--	172	--	22	--
SDIO	16	--	734	--	209	--
Total	457	356	5,830	3,584	692	429
Grand Total	813		9,414		1,121	

Of the 1,121 Phase I awards, 158 awards went to minority-owned businesses and 95 awards were to woman-owned businesses. Overall, 12 percent of the FY92 SBIR proposals were selected for funding.

In order to make information available on the technical content of the Phase I projects supported by the DoD SBIR Program, four volumes containing the abstracts and contracts for the awarded projects are published. The small business information with accompanying abstract are arranged in alphabetical order by firm name. Cross reference indices appear at the back of the volume for quick reference.

- Volume I contains Army Projects
- Volume II contains Navy Projects
- Volume III contains Air Force Projects
- Volume IV contains DARPA, DNA and SDIO Projects

Venture capital and large industrial firms that may have an interest in the research described in the abstracts in this publication are encouraged to contact the firm whose name and address is shown.

<sup>1</sup> As of March 15, 1993, DARPA changed its name to Advanced Research Projects Agency (ARPA). However, DARPA is used in this publication because the FY92 topics were issued and awards were made under the DARPA name.

## INTRODUCTION

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In 1982, Congress enacted and the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219), which created the Small Business Innovation Research (SBIR) Program to give small, high-technology firms a greater share of the federally-funded research and development contract awards.

Under the SBIR Program, each federal agency with an extramural budget for research or research and development in excess of \$100 million per fiscal year must establish an SBIR Program. The program is funded by setting aside 1.25 percent of the participating agency's extramural R&R&D contracting dollars. The agencies participating in the Department of Defense SBIR Program are the Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO).

The objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DoD research and development needs, encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development.

The SBIR Program consists of three distinct phases. Under Phase I, DoD components make awards to small businesses, typically of up to one man-year of effort over a period of six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas or concepts submitted in response to SBIR topics. Proposals selected for contract award are those which contain an approach or idea that holds promise to provide an answer to the specific problem addressed in the topic. Successful completion of Phase I is a pre-requisite for further DoD support in Phase II.

Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Proposals which identify a follow-on Phase III funding commitment from non-Federal sources will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period of 24 months, also subject to negotiation. The number of Phase II awards will depend upon the success rate of the Phase I effort and availability of funds. Phase II is the principal research or research and development effort, and requires a comprehensive proposal outlining the intended effort in detail.

In Phase III, an innovation is brought to the marketplace by private sector investment and support. No SBIR funds may be used in Phase III. Also, under Phase III, DoD may award follow-on contracts with non-SBIR funds for products and processes meeting DoD mission needs.

Proposals received in response to a DoD solicitation are evaluated on a competitive basis in the organization which generated the topic, by scientists and engineers knowledgeable in that area. Selections for Phase I are made in accordance with the following criteria:

- The scientific/technical quality of the research proposal and its relevance to the topic description, with special emphasis on its innovation and originality.
- Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.
- Anticipated benefits of the research to the total DoD research and development effort.
- Adequacy of the Phase I proposed effort to show progress toward demonstrating the feasibility of the concept.

The "Small Business Innovation Act of 1986" (P.L. 97-443) extended the "Sunset Clause" to 1993 and increased the taxation of the extramural research and development budget to 1.25 percent. The latest SBIR re-authorization law (P.L. 102-564), signed October 28, 1992, extends the program through 2000, doubles the taxation to 2.5 percent by 1997, and increases the average Phase I and Phase II award agreements.

AIR FORCE SBIR PHASE I AWARDS

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4 CYCLE TECHNOLOGIES, INC.

P.O. BOX 907

ROSLYN, WA 98941

Phone: (509) 649-3000

Title: Mission Area Planning

Abstract: A combustible mixture is compressed in the crankcase of a four-stroke cycle engine and forced into a boost plenum which houses the camshaft. The compressed mixture is metered by a throttle to intake valves of the engine. The engine is constructed from identical engine block elements rotated and joined to enclose centrally disposed crankcase and common boost plenum with the cylinders horizontally opposed.

Topic#: 92-153

ID#: 92WL6-160

Office: WL/POMX

Contract #: F33615-92-C-2291

PI: James M. Canode

ACCURATE AUTOMATION CORP.

1548 RIVERSIDE DRIVE, SUITE B

CHATTANOOGA, TN 37406

Phone: (615) 622-4642

Title: Parallel Neural Network Toolbox for Supercomputers

Abstract: This proposal involves research into a supercomputer-based environment for research into massively parallel neural-network algorithms for large scale, computationally intense problems. This environment will have application to areas such as image processing, pattern recognition, control signal processing, data compression, and fault diagnosis. All of these are areas which involve massive amounts of data and require extremely throughput speeds. We will investigate methods of parallelizing existing algorithms in our neural network toolbox for use on the silicon graphics line of workstations, the TI-TMS320C40, and the Cray 2. We will also investigate the application of a silicon graphics based explorer environment of the Cray. This environment will allow the manipulation and testing of both single neural network algorithms and systems of such algorithms. It will also provide a consistent and user friendly environment for research.

Topic#: 92-058

ID#: 92FL2-027

Office: PL/XPPP

Contract #: F29601-92-C-0102

PI: CHARLES THOMAS

ACCURATE AUTOMATION CORP.

1548 RIVERSIDE DRIVE, SUITE B

CHATTANOOGA, TN 37406

Phone: (615) 622-4642

Title: Methods for Reducing Plasma Effects on the Nasp

Abstract: We propose the development of an innovative neurocontroller that generates trajectories which reduce plasma effects on the communication system of the nasp. We will model plasma sheath generation and incorporate this model into a game flight simulator on a silicon graphics workstation. This model will then be used in the development of the controller and suitable adaptation laws. Cost functions which minimize communications blackouts and similar effects, as well as typical energy considerations, will be researched. We will investigate training the neurocontroller using the adaptive critic neural network based upon the heuristic dynamic programming, dual heuristic programming, or global dual heuristic programming concept. The application of drive reinforced learning and backpropagation-through-time as components of the adaptive-critic approach will also be investigated. This research draws upon control theory together with recent research results in neural networks. This approach offers the promise of increasingly intelligent and more autonomous flight controllers, and has advantages over traditional control approaches.

Topic#: 92-178

ID#: 92WL9-024

Office: ASD/NAF

Contract #: F33657-92C-2100

PI: ROBERT M. PAP

ADAPTIVE SENSORS, INC.

216 PICO BOULEVARD, SUITE 8

SANTA MONICA, CA 90405

Phone: (205) 981-2208

Title: Space-Time Adaptive Processing in Bistatic Airborne Radars

Abstract: Monostatic radar systems using space-time adaptive processing (STAP) have been simulated in detail and shown to provide large improvements in moving target detection and tracking capability. The proposed study will apply STAP technology to bistatic radars with airborne receivers and airborne or stationary transmitters. Cancellation of clutter in a bistatic radar is complicated by the rapidly varying spatial distribution of clutter doppler frequency. Bistatic STAP radar will be simulated in detail has important advantages - the radiation from either friendly or enemy radars can be used as target illumination, the

Topic#: 92-031

ID#: 92ES3-194

Office: RL

Contract #: F30602-92-C-0129

PI: DR. LAWRENCE E. BRENNAN

## AIR FORCE SBIR PHASE I AWARDS

receiving system can be carried on a drone or low performance aircraft, and the bistatic receiver is silent avoiding warning and arm attack. While STAP requires considerably more digital signal processing than conventional radar, digital processor technology is improving rapidly.

ADAPTIVE TECHNOLOGY, INC.  
309 CURTIS STREET  
SYRACUSE, NY 13208  
Phone: (315) 475-1121

Topic#: 92-102 ID#: 92WL2036  
Office: WL/AAOP  
Contract #: F33615-92-C-03117  
PI: DONALD R. MIEDANER

Title: Multiple, Integrated, Electronically Steered Arrays (ESA) Radar Performance Enhancement

Abstract: Multi-Dimensional adaptive processing techniques are proposed to detect low observable air-borne targets in difficult jamming and clutter environment. The problems of strong sidelobe jamming, main-beam clutter, side-lobe clutter, range-doppler spread of clutter, jamming generated terrain scattered interference (TSI) are addressed in the proposals. The combination of spatial, temporal and spectral adaptive processing are proposed to solve these problems. TSI imaging technique is proposed which uses the jamming energy to detect the target. The proposed approaches are supported by computer simulations with the simulation results presented in this proposal. The work plan includes determination of the processor architecture, system modeling and signal generation, algorithm development and processor simulation, performance evaluation and computational load reduction.

ADCOM SYSTEMS TECHNOLOGY, INC.  
PEABODY OFFICE BUILDING, ONE NEWBURY STREET  
PEABODY, MA 01960  
Phone: (508) 535-8008

Topic#: 92-031 ID#: 92ES2-018  
Office: ESD  
Contract #: F19628-92-C-0143  
PI: DR. ELIE J. BAGHDADY

Title: Radar Multipath and Clutter Suppression in Theatre Missile Defense

Abstract: Innovative approaches are proposed for analytical investigation and evaluation in a Phase I effort to develop multipath and clutter suppression techniques for low surface grazing angle CMW and MMW radar direct or differential guidance of a missile to a target in theater missile defense applications. The radar is either missile-borne or situated in the missile launch area or on the launch platform. An off-missile radar tracks a missile and targets at low elevation angles relative to its position, and determines what guidance correction might be necessary to communicate on an uplink to the missile in order to guide accurately to a particular target, or to a point beyond which autonomous-homing missile would be able to take over for a sure target hit. The multipath and clutter are via reflection/scattering of the outgoing radar and/or uplink signal, as well as of signal returns from missile and targets, off intervening terrain. This causes errors in the determination and tracking of missile and target angle and range positions, which errors combine in the vector difference to cause larger and larger percentage errors as the missile approaches the target location. The overall objective is to render negligible all errors due to multipath and clutter. The various approaches proposed will be evaluated for real-time effectiveness, implementation requirements, complexity, technical feasibility, performance reliability and cost-effectiveness trade-offs. The Phase I program will result in a specific multipath and clutter suppression technique and related algorithms, performance predictions and a plan for prototype implementation, validation and demonstration to Phase II.

ADROIT SYSTEMS, INC.  
809 NORTH ROYAL STREET  
ALEXANDRIA, VA 22314  
Phone: (703) 684-2900

Topic#: 92-146 ID#: 92WL6-131  
Office: WL/POMX  
Contract #: F33615-92-C-2270  
PI: THOMAS R.A. BUSSING

Title: A Novel Very-Low-Cost Airbreathing Propulsion System

Abstract: Currently, airbreathing propulsion systems which operate in the high subsonic regime are expensive, complex, heavy and use perishable fuels. To overcome these limitations, a novel propulsion concept based on a pulse detonation engine (PDE) or a Conventional ramjet Combustor (CRC) coupled with a boron solid fueled hybrid gas generator (HGG) is proposed. The innovation draws from recent successes in computational fluid dynamics and from systems engineering studies performed by the author. The proposed propulsion system has many highly desirable features including a very low unit cost, design simplicity, operational simplicity, and storability. The propulsion system can operate over a range of mach numbers and is well suited for propelling a standoff munition at high subsonic speeds.

## AIR FORCE SBIR PHASE I AWARDS

ADTECH SYSTEMS RESEARCH, INC.  
1342 N. FAIRFIELD ROAD  
DAYTON, OH 45432  
Phone: (513) 426-3329

Topic#: 92-016 ID#: 92AF0032  
Office: AFOSR  
Contract #: F49620-92-C-0032  
PI: SOM R. SONI

Title: Enhanced Chromophore Polymeric NLO Materials

Abstract: Nonlinear optical materials (NLO) are required for a variety of potential Air Force applications including optical signal processing (switches, modulators, and guided wave devices), and new laser sources (optical parametric oscillators and harmonic generators). However, presently available materials are unsatisfactory for many applications due to small nonlinearities, poor optical clarity, long responses times, difficulty in processing for devices, and other factors. Proposed efforts address material issues for amorphous polymer materials in thin film forms. Amorphous polymers in which molecular chromophore constituents have been aligned with a strong electric field (poled) represent a promising approach to materials with large second-order optical nonlinearities. Such materials combine the processability, mechanical strength, and typically excellent transparency characteristics of glassy organic polymers with the almost infinite molecular tailorability and high innovative techniques for preparing new materials or for improving the growth or processing of known materials will be investigated. NLO material developed in the northwestern university is in high demand and will be synthesized for industrial applications. Nonlinear optical materials will be examined only for the purpose of evaluating and demonstrating the properties of the material(s). Phase I of this program would demonstrate the proposed growth or processing techniques and potential applications. Phase II will develop advanced nonlinear materials and relevant processes to demonstrate potential. In Phase II, advanced nonlinear optical materials will be optimized for specific applications.

ADVANCED FUEL RESEARCH, INC.  
P.O. BOX 380379  
EAST HARTFORD, CT 06138  
Phone: (203) 528-9806

Topic#: 92-046 ID#: 92ES3-085  
Office: RL  
Contract #: F19628-92-C-0142  
PI: LAHMER LYNDIS

Title: Thin Film Magnet Structures for Non-Reciprocal Microwave Devices

Abstract: Requirement of heavy and voluminous permanent magnets in devices such as microwave generators, non-reciprocal circulators, isolators and their devices makes them unattractive of many space and weight restricted applications. Incorporation of these devices in large numbers for active apemure radar necessitates the development of small, monolithic circulators based on a thin film magnet technology. We propose to use laser ablation of specific metal alloy targets as the source of reactants for the synthesis and growth of thin films with the proper microstructure for achieving high-energy products and coercivity. Thin-films of RCOS and PR2FEI7NX ( $X = 2 - 3$ ) using pulsed laser deposition (PLD) is described, herein. Effects of wavelength and pulse dynamics on thin-film morphology will be investigated. Films will subjected to detailed magnetometry for characterization. Phase I will also entail design of a planar non- reciprocal microwave device and thin-film permanent magnet biasing structure. The ability to manufacture high-energy produd thin-film permanent magnets that have good

ADVANCED FUEL RESEARCH, INC.  
87 CHURCH ST  
EAST HARTFORD, CT 06108  
Phone: (203) 528-9806

Topic#: 92-074 ID#: 92PL3-039  
Office: PL/OLAC  
Contract #: F29601-91-C-0094  
PI: STEPHEN C. BATES

Title: Discrete Injection and Storage of Solid Oxygen

Abstract: Liquid oxygen systems are currently used in all high specific impulse, high thrust space propulsion systems. Although more energetic oxidizers have been demonstrated to exhibit superior performance, they have not been used because of their reactivity with materials and/or their hazards. Mixtures of powerful solid oxidizers with solid oxygen have been found to have greatly reduced reactivity and greatly increased stability. Solid cryogenic oxidizers are one part of what the American Space Exploration Initiative has recently recognized as the nationally critical technology of cryogenics. This proposal describes a solid oxidizer condensed directly into a solid, extruded, formed into pellets, and injected at high pressures. A constant injection rate that minimizes the possibility of combustion instabilities is achieved through mass-dependent pellet spacing. The work described in this proposal provides an example of technology transfer from a well developed specialized field (pellet fueling of fusion plasmas) to a promising new technology. The proposed storage, feed, and digital injection system is expected to be able to satisfy the rigorous requirements for the use of a solid oxidizer propellant.



## AIR FORCE SBIR PHASE I AWARDS

ADVANCED FUEL RESEARCH, INC.  
87 CHURCH STREET  
EAST HARTFORD, CT 06108  
Phone: (203) 528-9806

Topic#: 92-143 ID#: 92WL6-069  
Office: WL/POMX  
Contract #: F33615-92-C-2231  
PI: MICHAEL A. SERIO

Title: A Novel Test Method for Fuel Thermal Stability

Abstract: In the practical applications of hydrocarbon fuels in advanced aircraft, the most important consideration is to know under what circumstances the fuel will degrade to the extent that a deposit is formed. The development of this understanding of fuel behavior has been hampered by the lack of techniques for on-line measurement of deposit formation. The Phase I proposal is to develop an experimental system for monitoring the deposit rate and composition of surface deposits formed from degradation of jet fuel. The monitoring system would be based on a combination of FT-IR transmission spectroscopy and a Quartz Crystal Mass (QCM) detector. The FT-IR diagnostics would involve the use of a Fiber-Optic (F-O) element operated in an attenuated total reflectance (ATR) mode. The use of fiber-optics has provided the possibility of transmitting the IR light through a process stream under difficult operating conditions (high temperature, high pressure). ATR spectroscopy provides the possibility of analyses of highly absorbing materials by providing a reproducible, short path length. The QCM detector can measure microgram quantities of deposits and thus can provide real time data on fuel deposition. The Phase I result would be the demonstration of these diagnostic methods for measuring the onset of fuel degradation and for testing additives. The Phase II program would involve parallel testing of fuel/additive combinations in a larger scale system which more closely simulates the conditions in an aircraft fuel system along with comprehensive fluid dynamic modeling to establish the usefulness of the test device for obtaining fundamental data on fuel degradation. The device would be further improved and tested in Phase II and a commercial prototype would be developed, suitable for research or quality assurance applications.

ADVANCED TECHNOLOGY MATERIALS, INC.  
7 COMMERCE DRIVE  
DANBURY, CT 06810  
Phone: (203) 794-1100

Topic#: 92-130 ID#: 92WL5-093  
Office: WL/MLIP  
Contract #: F33615-92-C-5948  
PI: PETER C. VAN BUSKIRK

Title: Barrier Layer for Epitaxial Batio3 Films on Silicon

Abstract: Single crystal Batio3 has electro-optic and photorefractive properties that are among the most desirable of all inorganic media. The material also possesses ferroelectric properties and an exceptionally high dielectric constant, which make Batio3 films highly attractive for radiation hard and dram electronic memories. Use of Batio3 films for integrated electro-optics will require low optical losses, which is typically realized by growth on single crystal substrates, which cost hundreds of dollars per square inch and are not easily interfaced with SI integrated circuits. Recently the use of barrier layers was demonstrated in the growth of high temperature superconducting thin films on SI. Since these materials are similar to Batio3 this novel approach may allow the growth of epitaxial Batio3 thin films on silicon, although lower growth temperatures are needed to allow "silicon-like" processing. In Phase I the feasibility of low temperature plasma-enhanced metalorganic chemical vapor deposition (PE-MOCVD) of MGAL2O4 barrier layers on SI [100], will be determined. In Phase II an integrated process for the growth of epitaxial Batio3 on the MGAL2O4 / SI [100] substrate will be developed. The economic advantages of this unified approach for growth of Batio3 films on silicon will stimulate the manufacture of low cost electro-optic devices.

AEGIS RESEARCH CORP.  
3225 BOB WALLACE AVE., SW, SUITE I  
HUNTSVILLE, AL 35805  
Phone: (205) 534-2772

Topic#: 92-163 ID#: 92WL0-085  
Office: WL/MNPB  
Contract #: FO8630-92-C-0058  
PI: WILLIAM F. WAITE

Title: Laser Radar Scene Projector, Phase I Proposal

Abstract: This proposal addresses the development of a set of technical specifications for the establishment of a laser radar seeker hardware-in-the-loop (HWIL) testing and evaluation facility. Aegis research will determine the capabilities of seeker units anticipated to be tested by such a facility, determine a set of requirements based on these capabilities, investigate the current state-of-the-art in simulation facilities, and develop a set of specifications for the facility based on an evaluation of the options available for each requirement and the current technology base.

## AIR FORCE SBIR PHASE I AWARDS

AEROASTRO CORP.  
520 HUNTMAR PARK DRIVE., SUITE 100A  
HERNDON, VA 22070  
Phone: (415) 940-1637

Topic#: 92-088 ID#: 92PL5403  
Office: PL/OLAH  
Contract #: F04701-92-C-0035  
PI: DR. FRANK A. MCLOUGHLIN

Title: Compact, Low Cost Lidar System for Atmospheric Sensing

Abstract: World-wide wind velocity, both speed and direction, from the ground through 50,000 ft. altitude can be accurately measured using a small space-based payload. The proposed project will demonstrate that recent developed laser, detector and spacecraft technologies can be exploited and integrated into a small, low cost, space-based wind mapping system which can be configured either as a module aboard a larger satellite (e.g. DMSP) or a free flying small spacecraft. Similar ground based atmospheric lidar systems have already been developed and successfully used. While space-based system concepts have been studied, requirements imposed by the laser and detectors selected in these earlier studies result in a very large complex and costly systems. The proposal outlines a system based completely upon proven technologies which makes possible a small, low power, space-borne platform that accurately characterizes global wind properties with twice daily updates. A system design will be developed which is realistic, practical and completely based on proven technologies which can deliver the timely, accurate data needed to affect a dramatic improvement in weather forecasting capability. Both the raw wind data and the accurate forecasts they make possible have advantages in the military, civilian government and commercial sectors.

AERODYNE RESEARCH, INC.  
45 MANNING ROAD  
BILLERICA, MA 01821  
Phone: (508) 663-9500

Topic#: 92-086 ID#: 92PL5401  
Office: PL/OLAH  
Contract #: F04701-92-C-033  
PI: DR. ANDREW FREEDMAN

Title: Stratospheric Ozone Perturbation By Sub-micron Al<sub>2</sub>O<sub>3</sub> Particles

Abstract: Aluminized composite solid rocket motor (SRM's) are a key component of US space launch and strategic rocket systems. These systems, which include the space shuttle's strap-on boosters, produce copious amounts of alumina (Al<sub>2</sub>O<sub>3</sub>) exhaust particles in both the micron and submicron size regions. A significant portion of these particles are deposited in the *lower and mid-stratosphere* where there is significant concern that they may catalyze chemistry harmful to the stratospheric ozone layer. This Phase I proposal directly addresses the question of whether SRM alumina exhaust particles can catalyze the photodissociation of the key stratospheric chlorofluoro- and bromocarbon compounds which supply the bulk of the halogen oxide radicals currently producing stratospheric ozone depletion by applying advanced surface chemistry analysis techniques to measure halocarbon sticking coefficients and ultraviolet photodissociation cross-sections on alumina exhaust particle surfaces. Potential Phase II experiments which would explore Al<sub>2</sub>O<sub>3</sub> exhaust particle catalysis of C10X and no X reservoir compounds are also discussed, along with methods to predict the impact of alumina particle catalyzed chemistry on stratospheric ozone depletion.

AEROMETRICS, INC.  
550 DEL REY AVENUE UNIT A  
SUNNYVALE, CA 94086  
Phone: (408) 738-6688

Topic#: 92-001 ID#: 92AFD-002  
Office: AEDC  
Contract #:  
PI: DR WILLIAM D. BACHALO

Title: A Real time Monitoring System for Non-Intrusive Soot Diagnostics

Abstract: The present work deals with the design, development, testing and implementation of a real-time monitoring system to determine the particle size distribution of soot. The novel technique shall make use of multi wavelength analysis of the light scattering properties of the particles to infer the particle index of refraction, the soot number density and the particle size distribution. The Phase I technical objectives are the following: a) investigate the feasibility of using multiwavelength light scattering to determine the scattering and extinction properties of sooting flows from which the size distribution of soot can be inferred; b) determine the particle dynamic range of the proposed instrument, sensitivity, and limitations as applied to the specified application; c) investigate the relative merits of using a single laser; d) develop a breadboard system from which preliminary measurements of soot can be measured from a laboratory scale flame. The effort shall consist of using three different wavelengths of laser light to obtain the light scattering and extinction from the soot particles to infer the complex index of refraction of soot, its concentration, and the particle size distribution. The use of solid state diode lasers and photo diodes shall be incorporated in the novel instrument to obtain a compact probe to be used in typical combustion environments.

## AIR FORCE SBIR PHASE I AWARDS

AEROSPACE COMPUTING, INC.  
339 PAONE DRIVE  
BOULDER CREEK, CA 95006  
Phone: (415) 604-3436

Topic#: 92-157  
Office: WL/MNPB  
Contract #: FO8630-92-C-0037  
PI: DR. LESLIE A. YATES

ID#: 92WI0404

Title: A Comprehensive Automated Aerodynamic Data Reduction System for Aeroballistic Ranges

Abstract: Aeroballistic ranges provide invaluable data for designing air deliverable munitions and armament. Present methods for obtaining aerodynamic coefficients for these munitions are cumbersome and time consuming. Data reduction involves a long sequence of individual steps which can take from several days to weeks. Because of the slow turn around time, errors are not corrected during the test. The inexperience and rapid turnover of personnel also contribute to lower data quality. The objective of this proposal is the development of a comprehensive automated data reduction system. With this system aeroballistic ranges will function more like wind tunnels, that is, preliminary data analysis will be completed within a day thus allowing timely corrections to scheduling, test parameters, and system calibration. An executive system will control the entire data reduction process. Individual elements will be written into modules that can be replaced or updated as technology improves; they can also be exercised independently for analysis procedures. The system will be user friendly with graphically oriented input and output. These changes to aeroballistic range operations will improve overall data quality. In Phase I, the skeleton of the executive system and rudimentary modules will be developed, and the system will be proved for simple cases.

AEROSPACE DESIGN & DEVELOPMENT, INC.  
P.O. BOX 672  
NIWOT, CO 80544  
Phone: (303) 530-2888

Topic#: 92-011  
Office: AFCESA  
Contract #: FO8635-92-C-0063  
PI: DR H. L. GIER

ID#: 92CE1-119

Title: Combined Supercritical Air System for Breathing and Body Cooling

Abstract: The use of supercritical cryogenic storage of air will permit the supply of breathing air for personnel engaged in emergency or hazardous materials activities. Because air storage is at cryogenic temperature (less than 180 degrees C) there is considerable cooling available for the user as the air is used. This combination of the breathing air supply and personnel cooling is unique in this development process. The storage dewar is under development on a Phase II SBIR from NASA/Kennedy so this proposal is to develop the cooling potential of the supercritical air mobility pack (SCAMP). The air must be warmed from the cryogenic storage temperature to a temperature which is acceptable for breathing. This warming of the air provides considerable cooling for the user. Phase I will be devoted to the distribution of that cooling, and to the development of the heat exchangers. Phase II would be directed to the prototype development of a breathing/cooling system and its integration into the protective suit of a fireman. Phase III would be the initial production of cooling units for the USAF.

AEROTECH ENGINEERING & RESEARCH  
3117 CAMPFIRE DRIVE  
LAWRENCE, KS 66049  
Phone: (913) 842-6398

Topic#: 92-169  
Office: WL/MNPB  
Contract #: FO8630-92-C-0027  
PI: DR. SAEED FAROKHI

ID#: 92WI0407

Title: Inflatable Smart Missile Wing Design Evaluation

Abstract: Three areas of active missile wing research will be pursued. The first section will evaluate the materials to be used in the inflatable wing spars, ribs, skins, pressure bladders and active elements. Specimens of high orthogonality composites (Polyurethane-Graphite) will be constructed along with sample isotropic bladder materials (nylon or teflon) so that their fundamental properties can be evaluated. Operating pressures, actuation capabilities and manufacturing techniques will also be determined. The second section will explore the layouts of the missile wing components. The placement of ribs, spars and active elements will be investigated from a design perspective. An experimental rig will be made to determine the utility of shape-memory-alloys as high stiffness wing-root actuators. Piezoelectric elements will be evaluated for their ability to provide roll and pitch control as well as suppressing vibration and flutter. The third section will explore the layout of the systems required for the deployment of the missile wing. High pressure, high temperature lines and regulation devices will be laid out on two candidate missiles. One missile will have low aspect ratio fins, the other will have high aspect ratio wings. Phase I concludes with a feasibility analysis of the inflatable, active missile wing.

## AIR FORCE SBIR PHASE I AWARDS

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SOLANA BEACH, CA 92075  
Phone: (619) 755-1277

Topic#: 92-029 ID#: 92AL-006  
Office: AL  
Contract #: F41624-92-C-5003  
PI: JAMES T. THOMES

Title: Computer Based Technologies for Advanced Training Systems

Abstract: Aetech will produce an automated tool to assist in the design and development of courseware for intelligent computer assisted instruction systems using enhanced human-computer interfaces. The automated tool, called the intelligent courseware developer, will use approved Air Force methods of instructional system development (ISD) to allow the Air Force instructional designer to build a course using these new technologies. The system will be delivered as a user-friendly, production-quality program running on the standard Air Force Desktop III microcomputer and developed in ADA using the standard ADA compiler and tools of the Desktop III. Phase I will deliver a prototype CBT system which will demonstrate the concept and with a subset of the functions. Phase II will implement the remaining functionality of the system, test and deliver a working system written in ADA which can be easily modified and enhanced to accommodate new instructional strategies and technologies.

ALPHATECH, INC.  
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BURLINGTON, MA 01803  
Phone: (617) 273-3386

Topic#: 92-031 ID#: 92ES2-030  
Office: ESD  
Contract #: F19628-92-C-0132  
PI: RONALD M. JONES

Title: Directed Energy Laser Weapon Target Assignment

Abstract: The objective of the research is to develop and demonstrate directed energy weapon (DEW) fire control algorithms for ballistic missile defense. Earlier research conducted by Alphatech, Inc., for the Air Force Rome Air Development Center (RADC) demonstrated that the simulated boost-phase leakage through a dew system can vary by a factor of 2 or more using different tactics for assigning targets to DEWs. This research demonstrated that static rules for assigning weapons to targets performed significantly worse than target sequencing strategies that account for time-varying engagement geometries. This research suggested that advanced fire control strategies are required to properly establish dew capabilities and effectiveness. We propose to develop target sequencing strategies that account for time-varying weapon-target engagement geometries. The determination of the optimal strategy requires the solution to a dynamic programming (DP) problem, an undertaking that is computationally intractable for realistic scenarios. The innovation of our approach is to approximate the DP problem using heuristics. In phase one of this effort we will develop prototype implementations of these algorithms and integrate them into a BMD simulation. We will demonstrate the effectiveness of these algorithms on global protection against limited strike (GPALS) threat scenarios.

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Topic#: 92-031 ID#: 92ES2-044  
Office: ESD  
Contract #: F19628-92-C-0133  
PI: MS. KENDRA MOORE

Title: Military Airlift Command (MAC) Command, Control, and Communications (C3) System Assessment

Abstract: The objective of this research is to determine the feasibility of using advanced petri net technology to analyze the performance of large-scale C3 systems. The US Air Force is undergoing a major restructuring of its forces in response to the changing global situation and the resulting shift in defense needs and priorities. This reorientation will have a significant impact on Air Force missions, concepts of operations, and on the C3 systems which support them. Air Force C3 systems planners need a tool that can estimate C3 system performance in terms of their impact on mission effectiveness and warfighting capability. Alphatech has developed an interactive, graphical simulation tool called modeler, specifically for quantitative C3 system performance evaluations. Modeler uses advanced petri net models of communications, computers, and concepts of operation to estimate the impact of the alternatives on mission effectiveness and operator workload. Alphatech proposes using modeler to provide a quantitative evaluation of the C3 systems supporting the Military Airlift Command (MAC). In Phase I, we will model, simulate, and assess the performance of C3 systems supporting wing-level mac operations. In Phase II, we will develop a full scale model of mac C3 operations from the wing-level through the NAES to HQ MAC.

## AIR FORCE SBIR PHASE I AWARDS

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Topic#: 92-055 ID#: 92PL2-006  
Office: PL/XPPP  
Contract #: F29601-92-C-0068  
PI: DR SOL. W. GULIY

Title: Evaluation Techniques for Adaptive Optics Control Systems

Abstract: This proposal will refine recent stability-robustness and performance-robustness methods from multivariable feedback control theory and use these concepts to develop practical testing techniques, and eventually testing hardware, for evaluating performance properties of adaptive optics systems. The key to the development of the testing methodology and hardware is the experimental calculation of the singular values versus frequency of relevant (sensitivity and closed-loop) transfer function matrices associated with the adaptive optics feedback control system. An automated testing procedure involving an integrated set of test hardware and software will be developed. This test hardware will inject a vector of sinusoids (amplitude and phase) at the system sensors for a range of frequencies. The software will translate this sinusoidal information into the appropriate singular values for evaluating stability margins, tolerances to structured and unstructured modeling errors, and performance-robustness using the so-called structured singular value methodology (microanalysis). Furthermore, through the use of the singular value decomposition (SVD) theorem, the experimental data can be used to derive a complete multi-input multi-output dynamic model of the closed-loop adaptive optics system.

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Topic#: 92-070 ID#: 92PL3-009  
Office: PL/OLAC  
Contract #: F29601-92-C-0081  
PI: THOMAS HEIMANN

Title: Development of Pultrusion Technology for Production of Thin-Walled Tubes

Abstract: The Air Force desires to pultrude very thin tubes. During Phase I, act will design a pultrusion system capable of automating the production of very thin-walled tubes, with wall thicknesses ranging from 1.0 to 0.2 mm. Some keys to reducing minimum pultrudable wall-thickness include the development of techniques for continuous in-line assembly of geometrically stable, arbitrarily-oriented fiber structures, the reduction of friction at the tooling-to-composite interface, and establishment of techniques that prevent crushing thin tubes in the gripper/puller mechanism. The Phase I design study will evaluate alternative fiber-forming methods including in-line winding, braiding and preform-wrapping. Techniques for reducing frictional force including innovative die design, moving die and/or mandrel components and low-friction coatings for tooling will be studied. Deformable gripping mechanisms designed to conform to products will be investigated. In order to establish a baseline for current technology, experimental work will be conducted to measure the smallest diameter epoxy-matrix tube that can currently be produced as a function of wall thickness and wind angle. During Phase II, hardware and processing techniques identified in the Phase I study as improved methods for producing thin tubes will be demonstrated. A function of wall-thickness and wind angle. During Phase II, hardware and processing techniques identified in the Phase I study as improved methods for producing thin tubes will be demonstrated.

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Topic#: 92-157 ID#: 92WL0-194  
Office: WL/MNPB  
Contract #: FO8630-92-C-0021  
PI: DR WILLIAM YUEH

Title: Optimal Trajectory Shaping Guidance Design for the Have Dash II Missile

Abstract: American GNC Corporation (AGNC) hereby proposes an integrated schedule of modeling, design, analysis, simulation, and evaluation (MDASE) of the problem of midcourse and terminal guidance of the have Dash II Missile. The guidance formulation incorporates objectives pertaining to minimum time, maximum velocity, maximum target acquisition, and minimum jamming effects. The optimal trajectory shaping guidance system, which is derived based on an analytical solution and singular perturbation method, achieves the following advantages: (1) combined minimum time and maximum terminal speed for increasing survivability of the launching platform and maximum maneuverability of the missile at the endgame, (2) robustness against terminal conditions such as target zone uncertainty, jamming, and target maneuver, and (3) compatibility with the terminal guidance law, which, in turn, simplifies the implementation and avoids mode switching effects. In Phase I the optimal trajectory shaping guidance will be applied to the Air Force have Dash II Missile system. The performance through extensive simulations, will be quantified and compared with existing designs. The midcourse guidance and target acquisition problems

## AIR FORCE SBIR PHASE I AWARDS

will be simultaneously addressed based on the existing trajectory shaping framework. The associated software will be developed and delivered. In Phase II the guidance law is demonstrated in a hardware-in-the-loop environment.

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Topic#: 92-107 ID#: 92WL2-088  
Office: WL/AAOP  
Contract #: F33615-92-C-1005  
PI: HAROLD J. SCREVEN

Title: Programmable Emitter Signature Generation

Abstract: A key area of laboratory test capabilities that needs improvement is the simulation of realworld corruption on radar signals, and the imperfections in pulse generation generic to all radar systems. Two primary requirements are the simulation of multipath phenomena and unintentional intrapulse modulations (UMOP). Both require the ability to generate precise amplitude, phase and frequency modulation within the pulse, and for multipath, to simulate the distributed nature of the pulse. The ability of a digital RF memory to generate high resolution amplitude, phase, and frequency modulations with timing resolutions to less than one nanosecond, makes it a likely candidate to implement the required simulation capabilities. The availability of low cost processor boards to perform the realtime calculations to control the DRFM, makes this application of drfm technology both feasible and economical. Phase I will produce a system architecture for the application of DRFM technology to both multipath and intrapulse modulation simulation. The final report will include performance specifications for the candidate architecture, including ranges and resolutions for all intrapulse modulations. The report will also outline algorithms and update rates for controlling multipath simulation. A design for an RF generator using a DRFM to perform precise intrapulse modulations will be defined.

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Topic#: 92-059 ID#: 92PL2-038  
Office: PL/XPPP  
Contract #: F29601-92-C-0025  
PI: RAYMOND S. LARSEN

Title: High Speed Data Acquisition System

Abstract: A technology development is proposed which will make possible digitizers of 4-5 Gs/s. Considerable design work has already been accomplished on the new technology, based on a extrapolation of existing ship technology which has been applied to a commercial product capable of sample rates up to 2 Gs/s. The proposed development uses a new version of the analog sampling array, a patented device developed for large multichannel physics experiments, and commercialized under license by Analytak, Ltd., in a modular VME package. These products currently offer the best price-performance available at bandwidths up to 350 MHz. Tradeoffs can be made to optimize the design to the specific application. The tradeoffs involve record length, sample rate, number of channels per module, dynamic range and overall accuracy. The record length is defined by the required time window, which is in turn defined by the duration of the event of interest. The fast analog memory, together with a high and low Z, gain switchable preamplifier of at least 1 GHz bandwidth, and associated timing circuits, will be relatively expensive; therefore, the unit will be designed to accommodate tradeoffs to optimize performance versus cost. A desired target is at least 10 bits of dynamic range, 12 bits digitizing resolution, and 6 effective bits at 750 MHz input frequency.

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Phone: (804) 865-7093

Topic#: 92-005 ID#: 92AED033  
Office: AEDC  
Contract #:  
PI: DR SIVA M. MANGLAM

Title: A Solid-State Subsonic Flow Vector Measurement Device

Abstract: A completely new, solid-state flow measurement device will be developed to measure and display three-dimensional airflow velocity vectors. Unlike conventional instruments, the proposed innovation will be characterized by high-frequency response and high sensitivity to meet the specified range of flow parameters. The innovation stems from the following significant advanced made by as&m in recent years: a) the discovery of a direct coupling between airspeed and frequency of flow oscillations at the leading-edge stagnation region, b) the development of accurate flow diagnostics techniques to identify the stagnation point, and c) the invention of constant voltage anemometry. A probe of specified geometry with orthogonal rows of micro-thin multielement sensors will be used in conjunction with a bank of constant voltage anemometers to simultaneously

## AIR FORCE SBIR PHASE I AWARDS

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determine the resultant velocity and the local flow direction in close proximity to aircraft inlets. The output from the instrument will be electrical signals which can be directly fed as inputs to a closed-loop system to control the magnitude and direction of the flow vector.

APA OPTICS, INC.  
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Phone: (612) 784-4995

Topic#: 92-018 ID#: 92AFO-050  
Office: AFOSR  
Contract #: F49620-92-C-0037  
PI: DR M. ASIF KHAN

Title: Atomic Layer Epitaxy of Boron Nitride

Abstract: We propose a Phase I research program aimed at depositing single crystal BN films over sapphire and silicon carbide substrates. Our plan is to employ a unique photo-assisted switched atomic layer epitaxy process. This we feel will reduce the single crystal epitaxy temperature values close to 1400°C. We also propose to use a unique multilayer buffering procedure to decrease the interface defects resulting from the lattice mismatch between the substrate and the BN film. We feel our innovations will result in good optical quality single crystal BN film. Subsequently we will also use the atomic layer epitaxy process to N- and P-type dope the BN layers.

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Topic#: 92-157 ID#: 92W10-081  
Office: WL/MNPB  
Contract #: FO8630-92-C-0040  
PI: MRS. R. KATHRYN TUCKER

Title: Finite Element Mesh Generation From A Solid Geometric Model

Abstract: The primary techniques for conducting vulnerability analyses of mobile or fixed targets are (1) probabilistic studies using simplified methodologies to model the entire system or problem and (2) first principles finite element or hydrocode calculations that model detailed physical interactions and study a specific problem or portion of a problem. Both types of analyses require a detailed target model. Because the target to be analyzed in a first principles calculation is often a portion of a target used in a probabilistic analysis, it is desirable to obtain input for both from the same geometric model. This effort will investigate the feasibility of generating a finite element mesh from the geometric solid and surface descriptions of a BRL-CAD solid model. An integrated volume meshing approach has the benefit of complete knowledge of the model, in contrast to an existing ray-tracing approach that does not and consequently has problems with fine detail such as rebar reinforcement. The suitability of the BRL-CAO surface description as a basis for development of a volume mesh will be determined. A limited prototype volume meshing utility will be designed and implemented. This integrated volume meshing approach will be demonstrated and compared to the ray-tracing approach. The overall suitability of the integrated volume meshing approach will be assessed.

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Topic#: 92-167 ID#: 92W10-109  
Office: WL/MNPB  
Contract #: FO8630-92-C-0039  
PI: WILLIAM L. HACKER

Title: Innovative Weapon Design For Improved Smart Fuze Sensing and Survivability

Abstract: Current designs of Air Force hard target penetrating weapons place the fuze well in the tail of the weapon. This location causes some difficulty for a smart fuze algorithm to discriminate between flexible body weapon response and the loading effects caused by the penetration of soil or concrete. The aft location also leads to catastrophic fuze failure when the weapon experiences a "tail slap." Changing the location of the fuze from the tail to another place in the weapon may lead to simpler, more robust smart fuzing and increase the fuze survivability as well. This effort will investigate the feasibility of placing the fuze in a hard target penetrating weapon in other locations than just the tail. The suitability of other locations in the weapon for smart fuzing and survivability will be determined. Innovative design concepts will be generated to house the fuze in alternate locations which incorporate loading environment, operational, and manufacturing constraints. The response of the most promising concept will then be computationally analyzed and evaluated.

## AIR FORCE SBIR PHASE I AWARDS

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Topic#: 92-066 ID#: 92PL1-015  
Office: PL/XPPP  
Contract #: F29601-92-C-0064  
PI: MAX L. LAKE

**Title: Metal Matrix Composites For Electronic Packaging**

**Abstract:** High circuit densities and power dissipation requirements for power sethish Phase I SBIR will investigate the feasibility of producing reliable simiconductor, microwave and microelectronic devices are driving thermal high-resolution satellite cloud climatologies (HRSCC's) from meteor property requirements for electronic packaging materials and designs. Logical satellite imagery. There is currently no DoD HRSCC database higher circuit densities result in increased power density, generally which meets the requirements for medium and long-range cloud forecasts expressed in terms of watts per unit area. Air cooling is limited. The HTSCC's show the frequency of occurrence of cloud cover, spatial power densities of 1W/cm2. At least an order of magnitude improve distribution of clouds, and cloud cover amount, and can be stratified will be needed for next-generation electronic packages, attaining by cloud type and cloud height. They are produced from both archives level, will require improvements in materials and innovative scheme and real-time data streams, and are produced exclusively from satellites. Also, existing electronic devices would benefit from improved there imagery. Phase I will determine how HRSCC's can be produced from TMAL management in terms of reliability. The proposed research program, USAF defense meteorological satellite program (DMSP) digital imager, will develop and test composite enhancements which will demonstrate how these new products can be applied to meet thermal conductivities significantly higher (up to 33% higher) TSAF operational requirements. These new high-resolution cloud production monolithic aluminum. Proposed composite enhancements are also exps are unique, and rely on innovative image processing techniques to maected to lead to substantial increases in the in-plane thermal conductive use of current technology meteorological satellite imagery. We will demonstrate how HRSCC's can serve as both an assessment and forecast tool. We believe this type of product has the potential to become standard cloud climatology reference for DoD. There is excellent potential for long term product development with applications for both the DoD and civilian operations that are impacted by clouds.

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Topic#: 92-137 ID#: 92WL6-049  
Office: WL/POMX  
Contract #: F33615-92-C-2240  
PI: JYH-MING TING

**Title: Novel Diamond/C/C Composites for Thermal Management**

**Abstract:** An innovative integral dielectric heat sink material, diamond/carbon/carbon composite, is proposed in this Phase I research for the use in future advanced electronic devices. Carbone/carbone composite has a higher thermal conductivity and lower density, and therefore a higher specific thermal conductivity, as compared to metals. However, carbon is also an electric conductor. We propose to apply diamond coatings to the carbone substrate for insulation. Diamond coatings not only provide an insulating layer but also avoid a thermal barrier that is generated by the conventional electrically-insulating coatings. In addition, the use of a diamond coatings carriers an opportunity that electric circuit prints could be done directly on the heat sink material. In this proposed Phase I research, we will first fabricate carbone/carbon composites by a chemical vapor infiltration (CVD) technique. Diamond will then be deposited on and into the composites by a plasma enhanced chemical vapor deposition (PECVD) technique. Various analysis will be carried out to evaluate the resulting composites. Upon the completion of this proposed Phase I research, a revolutionary heat sink material will be demonstrated.

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Topic#: 92-098 ID#: 92PL6-032  
Office: BMO/MYSP  
Contract #:  
PI: DR. ROBERT CAVALLERI

**Title: Replacement Refrigerant and System Evaluation**

**Abstract:** The current refrigerants used in the vapor cycle systems are scheduled to be phased out and replaced with refrigerants that are environmentally less hazardous. These refrigerants are being developed to replace those currently employed in residential and commercial applications and will also find use in military applications. In most refrigeration systems some type of compressor or pump is required. The proposed effort will investigate the use of a high efficiency, large displacement rotary compressor that uses these new refrigerants. This compressor has features incorporated into its design that minimize the amount



## AIR FORCE SBIR PHASE I AWARDS

of internal leakage, decrease internal friction and maximize the compressor displacement for the weight and volume of the compressor. Limited experimental tests will be performed on selected refrigerants for comparison to theoretical predictions.

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Topic#: 92-137 ID#: 92PL1-077  
Office: PL/XPPP  
Contract #: F29601-92-C-0101  
PI: MARGARET H. HANNON

Title: Lightweight, Light-Trapped, Thin GaAs Solar Cell for Spacecraft Applications

Abstract: Astropower is proposing the development of an ultra-lightweight, high performance, thin light trapping GaAs solar cell for advanced space power systems. A thin device leads to higher performance in terms of open circuit voltage, radiation resistance, and specific power. In a thin device, the incorporation of light trapping to extend the optical path length permits greater current generation than can be expedited from a conventional, thick GaAs solar cell. The use of an optical reflector increases the short circuit current and reduces the bulk recombination. The innovative design proposed for this Phase I program combines a ultra-thin GaAs solar cell with the optimum light trapping technology, while offering the added benefits of durability and low cost utilizing astropower's liquid phase epitaxy technologies. The goal is a 1.64 micron thick space survivable GaAs solar cell offering 24.5% efficiency (AMO, 1x), corresponding to 2906 W/Kg. The development of this technology can result in a revolutionary improvement in high survivability lightweight GaAs solar cell products for space.

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Topic#: 92-085 ID#: 92PL4-035  
Office: PL/OLAA  
Contract #: F19628-92-C-0085  
PI: J.L. MONCET/R.G ISAACS

Title: Advanced Technology for Satellite Microwave Water Vapor Retrieval

Abstract: Operational approaches for the retrieval of temperature and moisture profiles from DMSP microwave and millimeter wave sounder data are based on exploitation of the spectral information content of the data alone. Regression retrievals are constrained to a solution space defined by the climatological variance (CV) of the ensemble for which the statistics are developed. Global statistics maximize the same space and variance. This increases the family of possible solutions. Temperature and moisture profiles are often retrieved for assimilation within meteorological applications models which themselves can provide information on the atmospheric state. An example is their use in numerical weather prediction (NWP) models. NWP models dynamically constrain the possible states of the atmosphere (ie. forecasts of temperature and moisture profiles) through their model physics. This reduces the solution space for the retrievals from the CV of the regression solutions. Further constraints are possible through parameterization of the profile variances using empirical orthogonal functions (EOFS). The objective of this study is to explore the feasibility of employing physical constraints from meteorological applications models in a satellite data retrieval system consisting of retrieval approach and applications model physics. The desired outcome is to improve the accuracy of profiles with significant climatological variability such as water vapor.

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Topic#: 92-125 ID#: 92WL5-005  
Office: WL/MLIP  
Contract #: F33615-92-C-5956  
PI: LIAM S. GROENER

Title: Advanced Thermal Protection Materials Test Configuration

Abstract: The specifications and preliminary hardware designs for a new test configuration for the AEDC heat facility will be developed. This test configuration is tailored specifically for the evaluation of thermal protection materials for hypersonic aerodynamic weapons (HAWs). In particular, it will provide a simulation for the long thermal soak period experienced by these weapons, as well as preliminary and final periods of high heating.

AXIOM CORP.  
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Topic#: 92-151 ID#: 92XRX-082  
Office: ASD/XRX  
Contract #:

## AIR FORCE SBIR PHASE I AWARDS

Phone: (791) 242-8600

PI: CASS G. PANCIOCCO

Title: Cost Methodology for Premilestone I Planning

Abstract: Project Objectives: The primary objective of this effort will be the development of a cost methodology for Premilestone I planning for emerging technology weapons systems/subsystems. The proposed effort also addresses cost related activities for progression through Premilestone 0 and Phase 0 leading up to a successful Milestone I decision. Aeronautical Systems Division (ASD) emerging technological issues as they relate to establishing a reliable defensible, and traceable cost estimating methodology will be addressed. These technologies include integrated avionics architectures, turbine engine capabilities, high temperature materials, and dollar/pound relationships. Approach: Axiom will utilize existing and updated approaches for this cost methodology development effort. Axiom's approach includes development of an overall Premilestone I cost estimating and modeling approach, development of data collection plan based on ASD/XRF and axiom references, development of a modelling and cost estimating relationship (CER) plan, construction of a sample model, proof of methodology concept through modeling of a specified asd technology, and development of a Phase II plan which evolves from the Premilestone I cost estimating methodology. Results: results of the Phase I effort include an emerging technology Premilestone I cost estimating methodology, data collection plan, CER development plan, proof of methodology concept, and Phase II planned approach.

BIHRLE APPLIED RESEARCH, INC.

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Title: Forebody Flow Controls for Chined Forebody Configurations

Abstract: The external configuration of advanced, low-observable aircraft have evolved to include chined forebodies. At the same time, agility requirements have been added to maneuver well into the high-angle-of-attack region where conventional controls are limited. It is proposed to examine the capability of forebody vortex control devices, such as asymmetrically deployed strakes and blowing (or suction) slots or jets on such chined configurations to develop alternate high angle-of-attack control schemes for these advanced designs. This effort would examine such devices under both static and dynamic conditions, such as during a velocity vector rolling maneuver, by measuring their effectiveness while rolling on a rotary balance. This will determine their ability not only to initiate a control moment but to generate an arresting moment, as well. Because vortex manipulation techniques result in a finite lag between control application and moment generation, with possible non-linear transients any time dependant characteristics of these devices will likewise be determined.

Topic#: 92-122

ID#: 92WL4016

Office: WL/FIOP

Contract #: F33615-92-C-3002

PI: JOHN N. RALSTON

BUSEK CO., INC.

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Title: A High Thrust Density, C60 Cluster, Ion Thruster

Abstract: High intergrid space charge limits the thrust density of an ion engine to the extent that these thrusters are presently practical for limited number of missions. By replacing the current propellants of choice (XE, Hg) with a carbon cluster propellant, called fullerene, this disadvantage is largely eliminated. Fullerene, C60, is a recently discovered form of carbon that has mass, stability, and low ionization potential that make it an excellent candidate for an ion thruster fuel. A C60 ion thruster could provide up to a factor of 30, increase in thrust density over the current propellants and a simultaneous relative loss reduction by a factor of 55. The high thrust density causes a reduction in required accelerator grid areas to a size that is practical even for large megawatt size thrusters. The objective of the Phase I effort is to provide answers for the key C60 ion thruster feasibility issues. The fullerenes will be evaporated, ionized and accelerated in a small scale low cost experiment. Supporting analytical work will proceed concurrently. The issues that will be addressed include vapor generation, electrode poisoning, ionization, fragmentation and ion acceleration. During Phase II, a prototype C60 thruster will be designed and constructed.

Topic#: 92-015

ID#: 92AFCA45

Office: AFOSR

Contract #: F49620-92-C-0039

PI: V. J. HRUBY

## AIR FORCE SBIR PHASE I AWARDS

CAMBRIDGE SCIENTIFIC, INC.  
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Topic#: 92-132 ID#: 92WL5-109  
Office: WL/MLIP  
Contract #: F33615-92-C-5944  
PI: DEBRA J. TRANTOLO, PH.D.

Title: "Biopolymer - Based Nonlinear Optical Materials"

Abstract: Recent development of materials with large second and third order nonlinear effects has generated interest in applications to future telecommunications and electronic systems. The ideal nonlinear optical material (NLOM) for most applications would have a very large nonlinear response, extremely low switching thresholds and rapid switching times. Popular approaches for the generation of polymers exhibiting second harmonic generation (SHG) include poling linear polymers or networks containing dissolved, NLO-active chromophores, or polymers to which suitable chromophores have been covalently attached. However, chromophore alignment during poling in these materials is never perfect. Rather, a distribution of alignment directions exists, and of course the nlo response is compromised. We believe that biopolymers offer the best opportunity to achieve virtually complete alignment of chromophores. The Phase I work is directed to development of nonlinear optically (NLO) active materials with enhanced second harmonic generation (SHG) based on noncentrosymmetric biopolymers. Polypeptides (molecules with chiral spatial configurations) will be derivatized to bear moieties with finite molecular polarizability. Investigations include (1) polypeptides directly derivatized with simple polarizable side groups, and (2) known SHG materials "derivatized" with polypeptides. SHG efficiency normalized to urea or KDP will be determined at 532 nm using the 1064 nm fundamental output of a q-switched ND:YAG laser.

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Topic#: 92-147 ID#: 92WL6-019  
Office: WL/POMX  
Contract #: F33615-92-C-2238  
PI: CALVIN C. SILVERSTEIN

Title: Advanced Endothermic Fuel Reactor

Abstract: An advanced Endothermic Fuel Reactor (AER) is proposed which utilizes a unique heat pipe configuration to transfer heat from hot components of a hypersonic propulsion system to endothermic fuel. This innovative concept responds to the high mach combined cycle engine technologies topic in the area of endothermic fuel reactor/engine integration and heat exchangers. Project objectives are: to establish that AER technology can effectively handle hypersonic propulsion heat loads, to establish that AER technology facilitates overall engine compactness and integration, and to identify key AER development needs. Project objectives will be achieved through completion of the following tasks: design and performance studies, concept assessment, and key technology needs. Anticipated results include: determination of AER size and weight, impact on engine performance, assessment of concept feasibility, and definition of key problem areas and needed R&D. Results will be directly applicable to Air Force hypersonic propulsion programs.

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CANTON, MA 02021  
Phone: (617) 354-0315

Topic#: 92-033 ID#: 92ES2-082  
Office: ESD  
Contract #: F19628-92-C-0138  
PI: DR. MELVIN D. FIELD, P.E.

Title: Centralized Fault Diagnostics and Correction for Dispersed Mobile Operations

Abstract: This program provides centralized fault diagnostics and correction capability for geographically separated network of data processing nodes performing dispersed mobile operations. It will have a capability to perform on-line diagnostics and correction from a central location within a multinode configuration of C3 elements in LAN and WAN configurations. There will be functions to evaluate the health of the provide appropriate error statistics on communications links, fault isolate malfunctioning devices to the lowest replaceable unit, and provide on-line debugging and correction of software problems. The capability will be modular in design and adaptable to various network configurations.

CENTER FOR REMOTE SENSING  
8260 GREENSBORO DRIVE, P.O. BOX 9244  
MCLEAN, VA 22102  
Phone: (703) 848-0800

Topic#: 92-181 ID#: 92WL9-052  
Office: ASD/NAF  
Contract #: F33657-92C-2109  
PI: DR. SUMAN GANGULY

## AIR FORCE SBIR PHASE I AWARDS

### Title: Potential for Ozone Enhancement In Relation to Supersonic Flights

Abstract: A large depletion of atmospheric ozone is occurring each austral spring over Antarctica. Referred to as the ozone hole problem, the concern is that ozone-poor air from the antarctic stratosphere is mixing with air at lower latitudes. Furthermore, there are indications that the size of the hole could increase and will continue to form for the next 90 years even if CFC releases are controlled. Such decreases in the protective ozone shield against destructive solar ultraviolet is extremely dangerous for the biosphere. The proposed research is dedicated to examining the possibilities of regenerating ozone and/or arresting its destruction by nullifying the effects of trace chemical species that deplete it. Towards this end, ozone-forming (or ozone depletion retarding) candidate species are postulated. Their possible reactions with various chemical species in the upper atmosphere are derived with the assistance of an artificial intelligence expert system. The candidate species are then assessed an ozone forming potential and feasibility (OFPF) grade based on the use of dynamical 1-d and 2-d model atmospheres and x-30s (the national aerospace plane) to deliver the needed chemicals to the stratosphere. A positive OFPF indicates a beneficial response of the atmosphere to the candidate species.

CFD RESEARCH CORP.  
3325-D TRIANA BLVD.  
HUNTSVILLE, AL 35805  
Phone: (205) 536-6576

Topic#: 92-014 ID#: 92AFO-040  
Office: AFOSR  
Contract #: F49620-92-C-0030  
PI: DR ANANTHA KRISHNAN

### Title: Influence of Supercritical Conditions on Precombustion Chemistry and Transport Behavior of Jet Fuels

Abstract: Advanced engine technology and hypersonic flight speeds of future military aircrafts place increasing heat load on jet fuels. The increase in heat load push the operation of fuels into their supercritical regime. The performance of future aircraft will be seriously limited if fuels cannot be operated effectively at supercritical conditions. The precombustion chemistry and transport processes at these conditions are not yet well understood. In this project, basic research experiments will be performed and advanced mathematical models will be developed to study the transport, and precombustion thermal degradation processes. The conditions on the transport properties and heat transfer processes. For this, theoretical models based on the hard sphere theory will be developed to obtain hydrocarbons property data base. For validating the models, experimental tests will be conducted at the University of Iowa under the guidance of Prof. L. D. Chen. In Phase II, additional experiments will be performed to understand supercritical precombustion chemistry to aid the formulation of chemistry models. The developed transport and chemistry models will be coupled with an existing CFD code.

CHARLES RIVER ANALYTICS, INC.  
55 WHEELER STREET  
CAMBRIDGE, MA 02138  
Phone: (617) 491-3474

Topic#: 92-164 ID#: 92WLO-168  
Office: WL/MNPB  
Contract #: FO8630-92-C-0032  
PI: DR ALPER K. CAGLAYAN

### Title: A Hybrid Neural Network/Knowledge Based Approach to Automatic Target Recognition

Abstract: There have been numerous automatic target recognition applications based on various methods including statistical pattern recognition synthetic discriminant functions, model-based vision, knowledge-based reasoning, and syntactic pattern recognition. These traditional approaches have not been able to provide a robust solution under target signatures and backgrounds varying in an unknown manner. The integration of neural network technology to atr systems offers several advantages: a rapidly adaptable on-line solution, capability for detection and classification of new classes of target types, and implementation efficiency on the VLSI designs. Here, we propose to formulate a hybrid neural network/knowledge base approach to ATR, to develop paradigms and algorithms for the ATR discrimination levels and to demonstrate feasibility on simulated target data in the visible range. Our approach is based on using our in-house hybrid neural network/expert system shell nuex and our case tool SDL with ada code generator. Our hybrid approach supports architectures composed of neural network, expert system, and image processing elements. Our neural network approach uses constraint based invariant features for target representation. The use of a priori knowledge about target signatures and background is accomplished with the expert system knowledge base interlinked with the neural networks in nuex.

COMPUTER SCIENCE AND APPLICATIONS  
2 CLIFFORD DRIVE  
SHALIMAR, FL 32579

Topic#: 92-157 ID#: 92WLO-030  
Office: WL/MNPB  
Contract #: FO8630-92-C-0060

## AIR FORCE SBIR PHASE I AWARDS

Phone: (904) 651-4991

PI: CLIFFORD H. ALLEN, JR.

Title: Electronic Combat Digital Simulation Workstation

Abstract: The Air Force Chief of Staff has directed program offices, operating commands, and test organizations to employ a disciplined test process throughout all phases of Electronic Combat (EC) systems development and modification. The EC test process consists of disciplined early evaluation to determine if the system under development will meet user needs followed by rigorous testing and evaluation to demonstrate that it performs as required. Full implementation of the EC test process requires the use of computer-aided simulation and analyses prior to each phase of testing to help design tests and predict test results. After each phase of testing, simulation and analysis are used to extrapolate test results to other conditions. DOD is also attempting to standardize digital simulation and modeling capabilities with which to develop, test, and assess capabilities of weapon systems in their operational environment. The key to this DOD effort is the development of a modeling and simulation architecture. The joint modeling and simulation system (J-MASS) program will develop a prototype standard digital modeling and simulation architecture under the auspices of the joint service CROSSBOW-S committee. The overall objective of the proposed SBIR Phase I program is to determine the feasibility of developing an accessible EC digital simulation workstation with a graphical user interface using: 1) the J-MASS (CROSSBOW-S) digital simulation architecture; 2) the standard DOD programming language ada; and 3) the USAF TAWC green flag EC model as a baseline level II and level III digital simulation model. Determining the feasibility of developing a methodology for interchangeability of non-real-time digital models with real-time digital model applications and techniques for the correlation of digital models results with various test facility results will also be accomplished.

CONCEPTUAL MINDWORKS, INC.

7042 ALAMO DOWNS PARKWAY

SAN ANTONIO, TX 78238

Phone: (512) 681-8766

Topic#: 92-020

ID#: 92AL-209

Office: AL

Contract #: F41624-92-C-9003

PI: DR HAROLD LONGBOTHAM

Title: Computer Modeling of Laser Damage to The Eye

Abstract: Modern warfare presents a risk of laser eye damage, either accidental or from deliberate enemy action. We propose to develop computer models which will allow us to simulate short pulse laser generated vision loss. These models will be checked against experimental data and adjusted as necessary. As they are perfected, they will increase the useful amount of data from animal studies by extrapolation. Two types of models will be developed. One will model acuity. The other will model actual VEP output. Both will use a simulated retina with a hexagonal tessellation, and model with actual data used in past VEP animal studies.

CONTINUUM DYNAMICS, INC.

P.O. BOX 3073

PRINCETON, NJ 08543

Phone: (609) 734-9282

Topic#: 92-009

ID#: 92CEL-077

Office: AFCESA

Contract #: F08635-92-C0067

PI: MILTON E. TESKE

Title: Microcomputer Model for Assessment of Fuel Dumping Impacts

Abstract: Fuel jettisoned by aircraft in flight may pose an environmental hazard. Recent decisions to convert from JP-4 jet fuel to the less volatile JP-8 jet fuel means that the likelihood for ground encounter by the jettisoned fuel is substantially increased. What is needed, for not only the U.S. Air Force but also the commercial airline industry, is a fully operational and user-friendly personal computer model that predicts the fate of the released fuel with confidence and reliability, including its downwind behavior and eventual ground footprint detail. Continuum Dynamics Inc. has developed such a model for the USDA forest service and the U.S. Army, to predict the dispersal of aerially released material. It is the gaussian line-source model called FSCBG. This proposal would modify FSCBG to the specifics of U.S. Air Force needs regarding fuel jettisoning. The user interface, extensive graphics capability, and efficient operation on personal computers have already been achieved in the original model for its original sponsors. Extension to the top of the troposphere, and to multicomponent mixtures, comprise the only modifications anticipated in Phase I. Results from this Phase I effort will go a long way toward accomplishing the goals envisioned in both Phase I and II of the solicitation objectives.

COSOFT DESIGNS, INC.

10300-54 CAMINITO CUERVO

SAN DIEGO, CA 92108

Topic#: 92-180

ID#: 92WL9046

Office: ASD/NAF

Contract #: F33657-92-C-2098

## AIR FORCE SBIR PHASE I AWARDS

Phone: (619) 281-3009

PI: DR. NATHANIEL L. COHEN

Title: Materials for High Temperature Antenna Applications

Abstract: There is a recognized need for improved antennas for use on hypersonic vehicles such as the X-30. This proposal has as its main objective the identification and/or development and evaluation of materials for the design of improved antennas for operation in the high temperature environment of hypersonic vehicles. The work plan includes the establishment of a baseline antenna element to provide a practical framework for the work to be done. Potential candidate materials will be identified and candidates selected. Selected materials may represent new developments such as composites of alumina and titania fiber and composites of reticulated foam ceramics. Test samples will be prepared, test fixtures for electromagnetic testing will be built and selected samples measured for appropriate parameters. A test antenna using material proving to meet the required criteria will be designed.

CREARE, INC.

P.O. BOX 71

HANOVER, NH 03755

Phone: (603) 643-3800

Topic#: 92-065

ID#: 92PI.2-042

Office: PL/XPPP

Contract #: F29601-92-C-0032

PI: FRANCIS X. DOLAN

Title: High Output Thermocouples for Cryogenic Temperatures

Abstract: Thermocouples are not frequently used for cryogenic temperature measurements due to lack of calibration data and poor accuracy of common thermocouple junction materials at low temperatures. In this project we will develop thermocouples with high output sensitivity for improved accuracy at cryogenic temperatures. Measurement requirements will be determined for Air Force facilities which are used to expose materials and devices to intense nuclear and other energetic radiation sources in order to evaluate survivability in defense scenarios. Multiple junction thermocouples will be fabricated and tested to demonstrate high output and wide temperature measurement range with good accuracy and resolution. Fabrication methods for thin-film thermocouples will be evaluated in order to select approaches that would provide the required temperature data from tests during Phase II in Air Force cryogenic environment facilities.

CREARE, INC.

P.O. BOX 71, ETNA ROAD

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Phone: (603) 643-3800

Topic#: 92-145

ID#: 92WI.6-077

Office: WL/POMX

Contract #: F33615-92-C-2230

PI: DR VICTOR IANNELLO

Title: A Novel Auxiliary Bearing for Turbine Engines

Abstract: The auxiliary bearings will be critical component of advanced gas turbine engines that use magnetic bearings to support and position the engine spools. Because of the high temperatures in the bearing compartments, conventional oil lubricated bearings cannot be used either as the main or auxiliary bearings. Although solid lubricated bearings under development are capable of supporting high loads at high temperatures, their short lifetime limits their use for manned aircraft engines. The proposed innovation will potentially overcome this limitation. A novel bearing configuration combines the attributes of solid and gas-film lubrication. Under conditions of light loading, the engine shaft is supported by a gas-film without mechanical friction or wear. High loads of short duration are sustained by dry lubricated surfaces, which may be either coated or powder-fed. The auxiliary bearing also includes an interface with the magnetic bearing controller for signaling when bearing overloads will occur. In Phase I, the feasibility of the auxiliary bearing concept will be assessed, and a preliminary design will be developed. The auxiliary bearings will be built and tested in Phase II. Creare will work with engine manufacturers in Phase III to incorporate the auxiliary bearings into advanced engines.

CREE RESEARCH, INC.

2810 MERIDIAN PARKWAY, SUITE 176

DURHAM, NC 27713

Phone: (919) 361-5709

Topic#: 92-114

ID#: 92WI.3-027

Office: WL/EIA

Contract #: F33615-92-C-1070

PI: John W. Palmour

Title: Evaluation of High Power 6H-SiC Microwave Field-Effect Transistors for High Temperature Operation

Abstract: There is an increasing need in many military systems to have solid state microwave devices with higher power capability, higher reliability, and higher operating temperatures. These devices would be important for airborne radar systems, electronic warfare and countermeasure systems, and airborne and space-based communications systems. While conventional

## AIR FORCE SBIR PHASE I AWARDS

semiconductor materials such as Si and GaAs are already being used near their limits of output power and operating temperature. The potential of SiC is just beginning to be demonstrated. High temperature 6H-SiC MESFETs and JFETs have been demonstrated to 500 C. Physical modeling has shown that an ideal 1  $\mu$ m gate length 6H-SiC MESFET at 25 C would have a power density of 3.2 W/MM at 10 GHz (3-6 times higher than achievable in GaAs). Furthermore, this modeling has shown that if the MESFET were operated at 500, it would still have an output power of 1.6 W/mm at 10 GHz. While the room temperature potential of the SiC MESFET will very likely be achieved, there are some factors that could prevent a MESFET structure from meeting its potential at high temperature. The amount of gate leakage known to exist for Scotch contacts at 500-600 C could degrade the RF performance of the devices. Therefore, it is proposed that 6H-SiC JET structures be investigated for high temperature, high frequency operation. The JET will take advantage of the much lower leakage current inherent in SiC P junctions at high temperature due to the wide bandgap. This effort will include physical modeling (RT and 500 C), design and fabrication of JET structures. High temperatures RF measurements of both MESFET and JET devices will also be performed. The most promising of these devices will be further developed in Phase II of this program. The most promising of these devices will be further developed in Phase II of this program.

CRYSTAL ASSOC., INC.  
15 INDUSTRIAL PARK  
WALDWICK, NJ 07463  
Phone: (201) 612-0060

Topic#: 92-130 ID#: 92WL5-222  
Office: WL/MLIP  
Contract #: F33615-92-C-5947  
PI: G.M. LOIACONO

Title: "Synthesis, Crystal Growth and Characterization of CSTIOASO4 Crystals for OPO Applications to 5 Microns"

Abstract: There is a need for optical crystals, having large nonlinear coefficients for operation as optical parametric oscillators (OPO) in the mid IR region (1.5 to 5.0 microns). Single crystals of KTIOASO4 (KTA) have been shown to have superior transmission in this optical region, however, the presence of a domain structure complicates the utilization of this material. In addition the nonlinear properties of KTA are reported to be considerably larger than KTP. In order to select the best material for this OPO application, the other members of the KTP family must be evaluated as single crystals. The synthesis, crystal growth and characterization of CSTIOASO4 (CTA) will be investigated in this program.

CRYSTALLUME  
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MENLO PARK, CA 94025  
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Topic#: 92-042 ID#: 92ES3-044  
Office: RL  
Contract #: F19628-92-C-0158  
PI: MAURICE LANDSTRASS

Title: CVD Diamond Coatings for a Tailored Work Function Cold Cathode

Abstract: Because of their unique electronic properties, diamond thin films offer an opportunity to greatly improve the efficiency of microwave power tube systems by using a high efficiency cold cathode employing diamond negative electron affinity coatings to achieve low work function and low emitter resistance in addition, because of diamond's thermal shock resistance and resistance to radiation and chemical attack, diamond coated cathodes may also improve the life and reliability of the power tube systems. This proposal is intended to explore the feasibility of diamond-coated cathodes and to determine the operational advantages of such systems in potential field applications. Nitrogen and phosphorus doped diamond thin films will be grown and characterized physically and electronically. Vacuum diodes will be fabricated and the current-voltage characteristics measured as a function of cathode temperature and field to determine work function and resistance, establishing the feasibility of this approach to improving cathodes. Phase II will focus on fabricating and characterizing diamond cathode components for use in existing operational systems.

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Topic#: 92-066 ID#: 92PL1-029  
Office: PL/XPPP  
Contract #: F29601-92-C-0038  
PI: DR. M.D. DRORY

Title: Thermal management of electronic devices with diamond composite ceramics

Abstract: The evolution of electronics systems to smaller, higher density packages places enormous demands on heat removal capability. A large increase in the thermal conductivity of packaging materials would enable multiple solutions to thermal management of these advanced electronics packages. Crystallume's diamond ceramic material is capable of achieving most of

## AIR FORCE SBIR PHASE I AWARDS

the advantages of single crystal diamond in cost-effective net shape packages and therefore presents a unique opportunity to achieve such a breakthrough. This proposal describes the effort required to use diamond ceramic technology to produce circuit boards for wafer scale integration having thermal conductivity nearly equal to that of natural diamond (i.e. 4 to 5 times that of copper). The goal of Phase I is to produce diamond ceramic for use as circuit boards with thermal conductivity measurements of 15 to 20 W/cmC. This will be accomplished by microstructure optimization of the ceramic body to achieve full density through the appropriate selection of starting diamond powder sizes and the inclusion of nucleation enhancers. Net-shape formation will be achieved by development of a gas flow-through method which exploits chemical vapor infiltration concepts to form fully dense substrates. To properly gauge the progress of the proposed work, the samples will undergo tests of thermal properties to be measured against assumed loadings and configurations.

### CRYSTALLUME

125 CONSTITUTION DRIVE  
MENLO PARK, CA 94025  
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Topic#: 92-138

ID#: 92WL6-156

Office: WL/POMX

Contract #: F33615-92-C-2233

PI: MAURICE LANDSTRASS

Title: Diamond Capacitors for Aircraft Power

Abstract: The unique ruggedness of diamond thin films offer an opportunity to greatly improve the reliability of power conditioning capacitors using highly radiation tolerant insulators fabricated from CVD diamond. Diamond coatings high compatibility with refractory metals and excellent properties at elevated temperatures will improve the thermal cycling capability and high current handling of power capacitors. In addition, because of diamond's thermal shock resistance and resistance to radiation and chemical attack, diamond capacitor insulators may also improve the life and reliability of avionic power systems. This proposal is intended to explore the feasibility of diamond insulators in capacitors and to determine the operational advantages of such systems in potential field applications. Insulating diamond thin films will be grown on engineering metal surfaces and characterized physically and electronically. Insulator test structures will be fabricated and the current-voltage characteristics measured as a function of capacitor temperature, electrode curvature and surface texture establishing the feasibility of this approach to common capacitor configurations. Phase II will focus on fabricating and characterizing diamond multilayer capacitor components for use in existing operational systems.

CSA ENGINEERING, INC.  
2850 WEST BAYSHORE ROAD  
PALO ALTO, CA 94303  
Phone: (415) 494-7351

Topic#: 92-071

ID#: 92PL3-015

Office: PL/OLAC

Contract #: F29601-92-C-0080

PI: DAVID A. KIENHOLZ, P.H.D.

Title: Modular Piezoelectric Damping Element for Flexible Structures

Abstract: This proposed program will integrate recently developed passive and active vibration suppression piezoelectric design concepts into an innovative vibration and motion control module or patch which can be attached to the surface of various type structural elements. Each patch unit will be designed to sense and control typical axial, bending and torsional deformations inputs. Design concepts will be developed and demonstrated to pave the way for a full-scale Phase II demonstration. Techniques for constructing actuators, sensors and control electronics will be established which allow the integration into a single module. Multilayer piezoelectric materials will be used as actuators to cancel unwanted vibrations. Concepts for the attachment method will also be developed. The main benefit of this product development and engineering effort would be the transfer of extensive, previously developed control theory and technology to actual applications. In the long term these devices could be provided in a productized form.

CSA ENGINEERING, INC.  
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PALO ALTO, CA 94303  
Phone: (415) 494-7351

Topic#: 92-072

ID#: 92PL3-021

Office: PL/OLAC

Contract #: F29601-92-C-0041

PI: DAVID A. KIENHOLZ, PHD

Title: Suspension System for Dynamic Testing of Space Structures

Abstract: Realistic ground vibration testing of flexible spacecraft requires a means for supporting the test article in 1-g without imposing constraint forces due to stiffness, mass, damping, or friction. Spacecraft having large, flexible appendages with high area/mass ratios are particularly difficult because air effects require that they be tested in a vacuum. The proposed development



## AIR FORCE SBIR PHASE I AWARDS

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will attempt to enhance the pneumatic-magnetic suspension system developed earlier by csa engineering to operate in a vacuum and to accommodate vertical motions of up to six inches. Other design goals will include vertical suspension frequency of 0.1 Hz or lower and friction less than 0.005% of payload weight. In Phase I, a single suspension device will be designed, built, and tested.

CYBERNET SYSTEMS CORP.  
1919 GREEN ROAD, SUITE B 101  
ANN ARBOR, MI 48105  
Phone: (313) 668-2567

Topic#: 92-058 ID#: 92PL2-031  
Office: PL/XPPP  
Contract #: F29601-92-C-0040  
PI: CHARLES J. JACOBUS

Title: Exact Neural Configurations From Training Examples - Generating Neural Rule Sets

Abstract: Much recent work has been focused on elucidating the potential benefits of using fuzzy logic and adaptive network decision making methods. Adaptive methods, like back-propagation taught neural networks, can make it possible to build complex decision making system which avoid the "expert systems" problem of manually acquired knowledge "capture." Instead, these adaptive methods capture knowledge by "learning" from example datasets which relate inputs to desired outputs (such as the decision of a seismic expert). Unfortunately, very little is known about how to structure neural networks optimally for particular decision making tasks, how much training is necessary for adequate network performance, and how to validate trained network performance relative to specifications. We propose implementing a supercomputer network training, decision making, and validation testbed which will incorporate a variety of popular adaptive network models, and will provide a means for testing some proposed concepts for network synthesis which may make designing adaptive networks to a specification more easily done for image data interpretation.

DATA FUSION CORP.  
7017 S. RICHFIELD ST  
AURORA, CO 80016  
Phone: (303) 699-2421

Topic#: 92-101 ID#: 92WL2-020  
Office: WL/AAOP  
Contract #: F33615-92-C-1074  
PI: DR W. KOBER

Title: An Analytic-Based Sensor Management Software Package

Abstract: Data fusion corporation proposes the Phase I investigation into the mathematical issues involved in the development of an analytical model for the management of sensor resources in tactical aircraft. This model will incorporate the analytic hierarchy process (AHP), a matrix eigenvalue-eigenvector method for formulating a scale of absolute priorities for pair-wise relative priorities among potential actions. It will also incorporate time-dependent value functions for these actions. Potential sequences of actions will be evaluated using non-myopic decision theory. Finally, the prioritization will accommodate either bayesian or a modified version of the dempster-shafer formalism for incorporation of uncertainties into the computations. Phase II will be directed toward the development of an interactive simulation test bed which implements these models and exercises them under tactically meaningful scenarios, resulting in developed, tested and documented algorithms for embedded applications. Phase III would be directed toward the development of an Ada software package suitable for a real-time, embedded system.

DEACON RESEARCH  
2440 EMBARCADERO WAY  
PALO ALTO, CA 94303  
Phone: (415) 493-6100

Topic#: 92-111 ID#: 92WL3-011  
Office: WL/ELA  
Contract #: F33615-92-C-1061  
PI: David Deacon

Title: Diode Laser Pumped Infrared Oscillator

Abstract: Deacon research has developed the theory behind a new concept for a tunable infrared laser source. Our approach will deliver tunable coherent radiation across the 1 to 10 micron range with high efficiency. Since it is based on solid state pumping, the device will be very compact and rugged, enabling a range of new applications. All of the component technologies have been demonstrated separately either in our own laboratories or elsewhere, so the probability of success is high. In Phase I, we will design and acquire the custom mechanical and optical elements required, build a breadboard, and measure the optical losses which determine how closely this test apparatus approaches the theoretical threshold condition. This data will allow us to optimize the system design for the available technology, and to project the performance of an optimized system. In Phase II we will construct a prototype and measure its performance.

## AIR FORCE SBIR PHASE I AWARDS

DEEGAN RESEARCH GROUP, INC.

39 PORTER LANE

PORTSMOUTH, RI 02871

Phone: (401) 683-1799

Title: Soot Ion Quantification Systems

Abstract: Detection and measurement of soot in the exhaust of turbine engines is important from a tactical standpoint of aircraft vulnerability. Existing optical detection methods are subject to error and subjective analysis. A novel soot detection method is proposed for development. It relies on the electromagnetic energy radiated by ions embedded in soot particles. The frequency of the radiation is very low and is a function of the charge and mass of the soot particles. The intensity and frequency of the radiation is dependent on the local magnetic field and its detectability can be enhanced by increasing the field in the vicinity of the exhaust plume. The proposed effort builds on a previous DARPA project's results to quantify the observable electromagnetic information and to link it with soot yield and size distribution. It is possible that the proposed device can be made small enough to be carried aboard aircraft to participate in real-time combustion control.

Topic#: 92-001

ID#: 92AF1006

Office: AEDC

Contract #:

PI: THIERRY DEEGAN

DEVELOSOFT CORP.

1630 30TH STREET, SUITE 121

BOULDER, CO 80301

Phone: (303) 442-5729

Title: An Adaptive Neural Network Antenna Controller With Perfect Memory and One-Shot Learning

Abstract: Current phased-array control techniques are unable to adapt to antenna degradations and failures to produce an optimized radiation pattern. Adaptive control will minimize unpredicted failures, reduce maintenance costs, and increase machine availability. Develosoft proposes to design, develop, and test a neural network antenna controller which will continue to produce optimal output radiation pattern in severely degraded conditions. We will use perfect behavior radiation to compare actual with expected output radiation. Novel algorithms will update the adaptive network through one-shot learning that eliminates accuracy and convergence problems found in conventional gradient descent techniques. We will demonstrate the feasibility of perfect memory adaptive controllers as well as the effectiveness of one-shot update. Our researchers excel in the field of neural network applications to radar direction finding, beamsteering, and control. This approach has broad application to defense. We anticipate immediate application of adaptive control with one shot learning and perfect memory to robotics where expansion and deterioration of arm segments is a major concern. Also, we intend to apply these techniques to space applications that involve deterioration of stressed links.

Topic#: 92-049

ID#: 92ES3-119

Office: RL

Contract #: F19628-92-C-0126

PI: MARK YAGER

DISPLAYTECH, INC.

2200 CENTRAL AVENUE

BOULDER, CO 80301

Phone: (303) 449-8933

Title: Adaptive FLC/VLSI Optical Focal Plane Processor

Abstract: The proposed work aims to develop optoelectronic image processing devices that integrate photodetectors and light modulators into large arrays of "smart" pixels. These devices exploit a hybrid optoelectronic technology that places fast ferroelectric liquid crystal (FLC) light modulators directly atop versatile silicon VLSI circuitry. The devices now proposed will incorporate multiple photodetectors in each pixel, to give an adaptive device accepting simultaneous input of data and control signals. Simultaneous addressing of the multiple photodetectors will be accomplished by integrating the device with a matched microlens array that will direct optical inputs from different directions onto the various detectors within each pixel. These lenslet arrays additionally improve detector fill factor and modulator phase uniformity. Phase I will explore device designs with inter-and intra-cell processing, culminating in the construction of a 16 x 16 prototype with separate lens array. Phase II devices will integrate the lenslets with 256 x 256 pixel arrays.

Topic#: 92-037

ID#: 92ES3-004

Office: RL

Contract #: F19628-92-C-0134

PI: MARK HANDSCHY

DISPLAYTECH, INC.

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BOULDER, CO 80301

Phone: (303) 449-8933

Topic#: 92-087

ID#: 92PL5-002

Office: PL/OLAH

Contract #: F04701-92-C-0044

PI: MIKE O'CALLAGHAN

## AIR FORCE SBIR PHASE I AWARDS

### Title: Image Based Optical Switching

Abstract: Optical switching and interconnects are of growing interest due to the increasing demands for higher data rates and larger numbers of data channels created by advanced computing and communications systems. Free-space optical switching and interconnects (such as the image based switch) are attractive because of their potential for low cross talk and low complexity. Displaytech has experience with using spatial light modulators for beam steering, field-of-view steering, and the projection of computer generated holograms. These applications have a great deal in common with the image based optical switch.

DYNA EAST CORP.  
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PHILADELPHIA, PA 19104  
Phone: (215) 386-4884

Topic#: 92-157 ID#: 92WL0-166  
Office: WL/MNPB  
Contract #: FO8630-92-C-0028  
PI: PEI CHI CHOU

### Title: Effects of Solid-Mechanic Properties of Energetic Materials on Munition Sensitivity

Abstract: Traditionally, the detonation has been treated by the shock theory, and explosives and propellants have been considered as energetic fluids. Many solid properties have not been measured and are not available from the handbooks. Recent results in munition sensitivity studies show that shearing is one of the main mechanisms in causing detonation, and is controlled by certain solid properties. In the proposed program, a simple experiment will be performed to further confirm the shear initiation theory. In addition, a study will be made to identify all solid properties that may affect the sensitivity of energetic materials. These properties include: stress-strain curve under hydrostatic pressure, viscosity, and specific heats. The effect of initial crack size on the hot spot generation will also be studied. Test methods in measuring these properties will be recommended. Hydrocodes will be modified to include these solid properties, such that they can be used as design tools for munition sensitivity calculations. Dyna east has extensive experience in insensitive munition research, and has strong background in solid mechanics. It also has good contacts with DOD and DOE laboratories, and is best qualified to conduct this work.

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Topic#: 92-063 ID#: 92PL2-083  
Office: PL/XPPP  
Contract #: F29601-92-C-0030  
PI: KEITH A. HOLSAPPLE

### Title: Hypervelocity Collision Scaling: The Theoretical Foundations

Abstract: Space structures require protection from disastrous impacts of meteoroid and man-made space debris population. Limitations on experiments creates a need for a theoretically-sound basis for extrapolation to faster and larger impacting particles. This research will develop the theoretical foundations for the power-law scaling relations commonly used. The primary basis for those forms is a single scalar measure of the impacting particle which exists because the measures of the outcome of a collision occur at time and length scales large compared to those of the impacting particle: the effects are approximately those of a "point-source." Point-source solutions for realistic equations of state including dissipation, phase change and finite strength give the theoretical basis and the correct power exponents for scaling laws. The Phase I effort is to derive point-source approximate solutions for common metals, and to determine the resulting scaling laws for impacts into thick targets, in terms of the equation of state parameters. The Phase II effort will extend that work into the thin targets typical of the space station and other space structures, using the theoretical results augmented by code calculations and results from laboratories and the LDEF.

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Topic#: 92-007 ID#: 92CEL024  
Office: AFCESA  
Contract #: FO8635-92-C0066  
PI: MICHAEL M. CARRABBA

### Title: A Fiber Optic Aqueous Phase Trichloroethylene Sensing Instrument

Abstract: The purpose of this program is to develop a real-time chemical sensing instrument for detecting and monitoring of chlorinated organic solvent contaminants, particularly trichloroethylene (TCE). The proposed work is based on the principle of combining spectroscopic, electrochemical and fiber optic techniques. Spectro-electrochemical fiber optic sensing (SEFOS) is, in principle, a generic technique which can be adapted to many different sensing applications. The incorporation of spectroscopic detection, such as fluorescence, should enable nanomolar limits (i.e., PPB levels or less), unlike electrochemical

## AIR FORCE SBIR PHASE I AWARDS

methods which are generally limited by background currents due to impurities and non-faradaic processes. The technique has an advantage over current fiber optic chemical sensing methods in that the sensing only takes place when the electrode device is turned on. This enables long-term monitoring of a well/site to be accomplished with only one set of probe. The goal of the Phase I program is to test the feasibility of using spectro-electrochemical methods for the detection of the chlorinated organic solvent, TCE, in the range of aqueous concentrations from 5 PPB to the solubility limit. The goal of the Phase II program is to develop and test a fiber optic based prototype field portable instrument for the field screening/in situ monitoring of tce and other chlorinated organic solvent contamination.

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Topic#: 92-078 ID#: 92PI34057  
Office: PL/OLAC  
Contract #: F29601-92-C-0042  
PI: K.M. ABRAHAM

Title: Optimization of Electrolyte Batteries

Abstract: A research program to identify and improve the parameters which affect the performance of the Li polymer electrolyte/LiMn2O4 cell is proposed. The cell, using the highly reversible LiMn2O4 insertion cathode, will utilize a polyacrylonitrile based polymer electrolyte with a conductivity of  $> 10^{-3}$  ohm-cm-1 at room temperature. A major emphasis will be placed on determining the optimum composition of the composite cathode comprising LiMn2O4, carbon and polymer electrolyte, that delivers the best electrolyte batteries using a redox shuttle reagent added to the electrolyte. The overdischarge problem of the cell will be remedied by adding a small amount of a second rechargeable cathode material exhibiting a discharge plateau lower than that of LiMn2O4.

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Topic#: 92-150 ID#: 92XPA001  
Office: ASD/XRX  
Contract #: F33657-92-C-2082  
PI: STEVEN M. MOSHER

Title: Virtual Reality for Air Combat

Abstract: The principle objective of this contract will be to provide the Air Force with a low-cost high fidelity man-in-the-loop air combat simulation facility. The facility will provide the government with a critical technology the ability to simulate advanced technologies. This facility will have the following key features. 1. Provide real time 4 v 12 capability 2. Provide real time close-in combat capability 3. Utilize existing software - AASPEM 4. Utilize existing customer hardware 5. Incorporate virtual reality (VR) hardware the Phase I objectives are to develop the software and hardware modifications and display requirements for this simulator facility, and to demonstrate key technologies. Phase II objectives are to deliver a fully functioning simulator, including whatever hardware and software is required.

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Topic#: 92-109 ID#: 92WL3015  
Office: WL/ELA  
Contract #: F33615-92-C-1057  
PI: Dr Leonard S. Buchoff

Title: Improved Reliability and Functionality Through Compliant Interconnects

Abstract: Drawing upon unique experience with compliant connectors, and an established base of government activity and contractor contracts, Elastomeric Technologies, Inc. will conduct an in-depth survey and analysis of the compliant development field. Principal applications of concern are multichip modules, chip carriers, hybrid circuits, displays and board-to-board applications. Test and burn-in sockets will also be considered. Connector performance criteria will be delineated and prioritized with particular focus on coefficient of thermal expansion, thermal conductivity, stress relaxation (compression set), electrical characteristics, resistance to mechanical and chemical stresses, ease of application and potential for low cost, high volume production. Existing technologies will be reviewed and trade-off analyses conducted and promising systems recommended for Phase II development. Elastomeric Technologies, Inc. has over 15 years background in compliant connectors and is thoroughly versed in technologies currently applied in the field. The investigator is a leading authority in the field of compliant connectors and is thoroughly versed in technologies currently applied in the field.

## AIR FORCE SBIR PHASE I AWARDS

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Topic#: 92-068 ID#: 92PL1-071  
Office: PL/XPPP  
Contract #: F29601-92-C-0079  
PI: WILLIAM S. CHAN

Title: A Novel 3-Dimensional Chip Connection System Using Trench Filled Metallic Plugs

Abstract: Conventional two-dimensional integrated circuits despite their conspicuous progress in submicron domain have almost reached their limits in packing density. One way to achieve a high level of integration is to stack the circuit layers vertically to result in a three-dimensional chip system electro-optek proposed to develop an innovative three-dimensional chip connection system for fabricating hyper dense chips. The architecture involve staking a multiple layers of processed microcircuits utilizing specialized trench filled metallic plugs and wafer thinning procedures to form a three dimensional structure such that each layer will have a circuit which may be tested independently without affecting the other layers. In this program, we will use established technologies of micro-machining and microelectronic processing of silicon (Si) wafers to fabricate these circuit layers and the three-dimensional architecture. The resultant three-dimensional chip will process features of very high packing density leading to ultra-large-scale-integration (ULSI) and high speed to vericla interconnections associated with shorter lengths thus making them ideal for massively parallel and high speed signal processing applications. The resultant structures will also be radiation-hard and will be immune to toal dose and single-event upset rates due to thinner active circuit layers and the resultant smaller active volumes.

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Topic#: 92-096 ID#: 92PL6-047  
Office: BMO/MYSP  
Contract #:  
PI: V.K. RAMAN

Title: Radiation-Hard GaAs Bipolar Circuits for High Frequency Applications

Abstract: We propose to develop ultra radiation-hard complementary heterojunction bipolar transistor (CHBT) circuits for high frequency applications suitable for dense spaceborne systems. We will develop a self-aligned base ohmic metal (SAM) process with thin base structures to achieve very high cut-off frequencies close to 80 GHz. We will optimize the performance of N-P-N and P-N-P devices on the same chip using gaeIs/GaAs heterostructures for improving the packaging density. The CHBT devices will be specially developed for high speed analog systems such as A/D converters for present-day and future space systems. In Phase I we will model the CHBT device, delineate its fabrication process, design the device structure thus addressing solutions to critical issues involving radiation hardness, packaging density, power and noise performance. We will design a test chip to demonstrate the CHBT's high speed, low noise and low power capability. Since these devices are built on thin epitaxial films on semi-insulating GaAs substrate, they are ultra-radiation hard making them ideally suitable for use in radiation-rich environments.

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Topic#: 92-104 ID#: 92WL2-055  
Office: WL/AAOP  
Contract #: F33615-92-C-1055  
PI: MURRAY W. ROSEN

Title: Double Pull Electronic Counter-Countermeasures (ECCM)

Abstract: The Phase I project investigates and defines new ECCM techniques that will counter and negate the effects of double pull countermeasures. The project examines ECCM issues and alternate implementation approaches. Candidate ECCM approaches include: target decorrelation algorithms; homodyne signal processing techniques; spread spectrum REF coding; and PRF stagger coding. Phase I conducts radar processing and CM research; defines ECCM objectives and constraints; investigates and defines new ECCM techniques; conducts trade-offs and selects techniques; determines ECCM performance and technical feasibility; outlines prototype implementations to evaluate the new techniques; and develops a plan for future ECCM demonstration in a flyable brassboard model.

ELECTRONIC DECISIONS, INC.  
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URBANA, IL 61801

Topic#: 92-160 ID#: 92WL0-169  
Office: WL/MNPB  
Contract #: F08630-92-C-0052

## AIR FORCE SBIR PHASE I AWARDS

Phone: (217) 367-2600

PI: DR. DANIEL A. FLEISCH

Title: An Act-Based Range Extent Simulator

Abstract: A new type of range extent simulator has been made possible through recent developments in the emerging microelectronic technology of acoustic charge transport (ACT). This technology, developed jointly by DARPA and the U.S. Air Force, has enabled the implementation of digitally programmable analog multitap delay lines. Used as a programmable range extent device, the ACT device provides hundreds of user-selectable delays, each with variable amplitude, in a single microelectronic integrated circuit. The capabilities of the ACT range extent simulator go well beyond the simple fixed delays of cables; in this system, the user actually specifies the complete transfer function of the device. Thus, in addition to setting the desired group delay, the time-and frequency-domain response of the system may be tailored to the requirements of the test. The proposed project seeks to evaluate the feasibility of applying this revolutionary new technology to ref simulation applications by comparing the technical, environmental, and cost requirements of these applications with the capabilities of existing and planned ACT devices. An existing ACT tapped delay line will be used to simulate a variety of extended-range targets over a wide temperature range, and the resulting false target return will be examined to determine its utility for ref simulation applications. The results of this testing will be used in a preliminary design study which will describe the advantages and disadvantages of this approach.

EMF SYSTEMS

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Topic#: 92-093

ID#: 92PI.6-090

Office: BMO/MYSP

Contract #:

PI: DAVID F. SMITH

Title: Development of Second Generation Reserve Batteries for Strategic Missile Applications

Abstract: Reserve batteries with improved energy density and voltage regulation are needed which are capable of meeting existing and future strategic missile requirements. Silver oxide cathodes with superior thermal stability (aging) and voltage performance will be evaluated using new, unusually efficient electrode structures. An innovative hybrid cell construction, lightweight current collectors, and new lightweight electrolytes will be evaluated in subscale size cells. The best candidates will then be evaluated in full sizes cells in terms of activation, discharge performance, and weight. A battery layout design based upon the program results will be prepared at the completion of the Phase I work. The design will be compliant with the requirements for the APS.

ENERGY MATERIALS TESTING LABORATORY

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BIDDEFORD, ME 04005

Phone: (207) 282-5911

Topic#: 92-003

ID#: 92AED-025

Office: AEDC

Contract #:

PI: STEPHEN A. MICHAUD

Title: 2400k Gas Sample Cell

Abstract: A Phase I feasibility study is proposed for the development of a 2400 degree Kelvin gas sample cell which is capable of simulating the combustion products of hydrogen-air scramjet propulsion system at pressures from 0.5 to 2.0 atmospheres, flows from 0 to 1.0 standard liters per minute, and a cell composition of air with 20 percent water vapor by weight. Addressed within the proposal is the primary design requirement that the cell must accept laser raman spectroscopy diagnostic instrumentation and thus must incorporate UV grade optical view ports which introduce minimal distortion into the raman measurement. Consideration is made to the jamor subsystems required including the heating source, sample gas source, temperature control, pressure control, flow control, optical view ports and cooling and insulation packages. The subsystems are to be evaluated separately but with the goal of developing a workable gas sample cell. The result of the feasibility study will include a detailed description of the technique and equipment necessary to initiate a Phase II design and construction, and demonstration of a prototype system. The Phase I feasibility study in addition, will include a laboratory demonstration of a 2400 degree Kelvin gas sample.

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Topic#: 92-073

ID#: 92PI.1-925

Office: PI/XPPP

Contract #: F29601-92-C-0065

PI: TIMOTHY R. KNOWLES, PHD

## AIR FORCE SBIR PHASE I AWARDS

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Title: Phase-Change Composite Thermal Energy Storage for Ni-H2 Battery.

Abstract: Thermal control is a design driver for space applications of Ni-H2 battery systems. Compared with the Ni-Cd batteries they are replacing, the Ni-H2 batteries require lower operating temperatures and generate higher heat loads that increase cooling needs. The space radiators used for cooling are generally sized for the peak heat loads during battery discharge to avoid excessively high temperatures that shorten battery life. The radiators are then oversized at other phases of the cycle, necessitating back-up heaters to avoid excessively low temperatures. Thermal energy storage improves battery system performance by passively absorbing and storing reject heat for release during low load phases of the cycle, thereby permitting the radiator to be sized for the average heat load and reducing the system weight and size. In this project esli will design, fabricate and test a phase-change composite passive thermal energy storage unit for a generic Ni-H2 battery design. The composite consists of a heat conductor finely dispersed in a organic phase-change matrix that has high heat capacity in the temperature range of interest. The unit is designed for low weight, high overall thermal conductance, and capillary control of void distribution to relieve expansion stress. Phase I effort will study materials and design options, as well as test the behavior of composite samples under relevant conditions. Phase II would develop and cycle-test a prototype in relevant geometry leading toward subsequent flight qualification.

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Topic#: 92-112 ID#: 92WL3-036  
Office: WL/ELA  
Contract #: F33615-92-C-1069  
PI: W. David Braddock

Title: Novel Doping Sources for III-V Molecular Beam Epitaxy

Abstract: The development of four different doping sources for use within an MBE system is proposed. Two high purity, high uniformity sources for use with Carbon, and two such sources will be developed for use with Tellurium. The purity of the species produced by each cell will be studied with a Residual Gas Analyzer. Recommendations concerning the use of these cells in a solid source MBE system will be summarized in the final report.

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Topic#: 92-021 ID#: 92AL-104  
Office: AL  
Contract #: F41624-92-C-3000  
PI: ROBERT S. KENNEDY, PH.D.

Title: Isoperformance as a Framework for Human Systems Integration

Abstract: Isoperformance methodology is a set of formal relations (trade-off functions) among the determinants of performance; it is derived by fixing a desired level of performance and then solving for combinations of the determinants sufficient to produce that level. The isoperformance idea is not original with this proposal. What is original here is its use as a framework to guide the acquisition and design process. Isoperformance curves are empirically accurate depictions of the trade-off relations among the factors that determine performance, that is, accurate depictions of the form of those relations. Given the relations, it is possible to put questions of a very specific sort regarding possible hsi problems and to reason one's way through subsequent questions to possible resolutions. The present proposal indicates how this can be done. Phase I will result in the first draft of a script that will guide the user through the design process using a question-and-answer approach, with supplemental illustrative and informative materials. In Phase II, this script will be developed, refined, and recast as a computer program designed to run on Air Force standard microcomputers and written in ada. A natural post-application would be to take the same approach (a question-and-answer guide based on isoperformance relations) to mos restructuring.

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Topic#: 92-024 ID#: 92AL-138  
Office: AL  
Contract #: F41624-92-C-6004  
PI: GARY W JONES

Title: Helmet-Mounted Visual System Components and Assemblies - Miniature Cathode Ray Tubes (CRT's)

Abstract: This SBIR Phase I proposal specifically addressed 'early stage' development issues involved in applying field emission (FEA) technology to build a monochrome, flat screen, page size, high contrast, high resolution display. A 90 mm diagonal 700 x 7000 line black and white helmet display is the targeted Phase II product. Color displays and 138 mm diagonal displays

## AIR FORCE SBIR PHASE I AWARDS

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are targeted to follow the initial black and white display. Experimental work in this Phase I program will consist of building and demonstrating test pixels with phosphor coatings using a unique previously demonstrated fea technology. Micro-vacuum sealing and a unique anode design are special features of this program. The field emitters used in this program will be fabricated using a process the principal investigator of this project has successfully used to make high performance field emission devices. The overall display technology presented in this proposal contains what we believe is the optimum, synergistic combination of field emitter, cell structure, emission control, phosphor technology, vacuum encapsulation structures and processes possible at this time which appear readily manufacturable.

### FIBER AND SENSOR TECHNOLOGIES

P O BOX 11704

BLACKSBURY, VA 24062

Phone: (703) 231-4224

Title: Survivability Enhancement of Optical Fiber Data Busses by Structural Integration

Abstract: increased protection of optical fiber data busses would reduce aircraft system vulnerability to ballistic damage and increase the probability of accomplishing mission goals. Such data busses are employed to avoid electromagnetic interference, allow increased data rates, and decrease wiring harness weight. Because optical fibers are smaller than wire cables, their likelihood of direct impact damage is lower. By incorporating fibers within structural airframe materials, additional improvements in damage reduction may be possible. The principal investigators have attached fibers to and embedded fibers within aerospace materials for more than ten years, mainly for the purpose of measuring material properties. Attachment of fibers has been achieved using polymer and ceramic adhesives, as well as by flame spray and plasma spray methods. Fibers have been embedded within simple polymers, ceramics and metals, as well as within polymer, refractory and metal-base composites. Based on our experience with these methods, and taking advantage of fiber cable designs, Fiber and Sensor Technologies (F&S) proposes to determine attachment/embedding strategies. In Phase I, F&S and the Fiber & Electro-optics Research Center (FEORG) at Virginia Tech will determine alternatives to protect fibers integrated with structural material systems. Phase II would then investigate the effectiveness of those alternatives.

Topic#: 92-120

ID#: 92WL4-053

Office: WL/FIOP

Contract #: F33615-92C-3606

PI: KENT MURPHY

### FIBER AND SENSOR TECHNOLOGIES

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Phone: (703) 231-4224

Title: High Temperature Measurement Using Sapphire Optical Fiber Sensors for NASP Material Tests

Abstract: The measurement of strain at high temperature in candidate nasp materials is required in order to monitor material response under simulated operational conditions and to design efficient hot aerospace structures. Conventional contact resistive foil strain gages are not suitable for high temperature measurements due to reduced accuracy, requirement for frequent calibration, and debonding from test materials. Fiber and sensor technologies, Inc. proposes to demonstrate the feasibility of strain measurement at temperatures up to 3000°F on nasp candidate materials using sapphire fiber strain gages in both static and dynamic temperature test conditions, and to consider related implementation issues such as sensor attachment and signal processing. The 3600°F melting temperature of optical quality sapphire fibers suitable for fiber sensors, and the inherent immunity of fiber optical sensors to electromagnetic interference and ground loops make sapphire fiber-based strain sensors particularly advantageous.

Topic#: 92-179

ID#: 92WL9-034

Office: ASD/NAF

Contract #: F33657-92-C-2097

PI: KENT MURPHY

### FOSTER-MILLER, INC.

350 SECOND AVENUE

WALTHAM, MA 02154

Phone: (617) 890-3200

Title: An integrated Modeling Tool for Rapid Assessment of Reliability

Abstract: Analysis tool to provide reliability assessment of microelectronic devices/ assemblies subjected to thermal and mechanical stresses. Foster-Miller will use a unique modeling approach, known as "bond graph technique", to model and assess reliability in coupled energy domains (electrical, thermal, and mechanical) simultaneously. Bond graph technique is an energy-based analysis tool which makes the differences in energetic systems transparent. This simplifies setting up the

Topic#: 92-040

ID#: 92ES3-016

Office: RL

Contract #: F30602-92-C-0096

PI: DR. K. JAYARAJ



## AIR FORCE SBIR PHASE I AWARDS

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evaluations of state and allows the user to view the overall system, understand the reliability implications and isolate problem areas for further analysis. In Phase I, we will demonstrate key concepts of our proposed approach with a simple test case geometry subjected to thermal and mechanical stresses of MIL-STD test methods. In addition to predicting dynamic stress and temperature distributions, the model will also predict the impact of these tests on the electrical performance of the system. By including a small database of failure criteria for temperature, stress and tolerances on electrical parameters, we will demonstrate the model's ability to identify problem areas. The skeleton reliability assessment tool demonstrated in Phase I, will be expanded to include a comprehensive database consisting of standard cells to represent components and interconnects (which can be networked together to represent any electronic assembly), failure models, and all applicable MIL-STD test conditions in Phase II. Development of a user-friendly interface and on-site evaluation by selected oems including Honeywell solid state electronics division in Phase II will establish a firm basis for a commercially funded cad tool development in Phase III. This tool will permit evaluation of electronic assemblies subjected to dynamic

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Topic#: 92-075 ID#: 92PL3-043  
Office: PL/OLAC  
Contract #: F29601-92-C-0072  
PI: MARVIN GUILLES

Title: Liquid Crystal Polymer Cryo Composite Tank

Abstract: Significant weight reduction and improvement in thermal management can be achieved in cryogenic tank systems through the extensive use of liquid crystal polymer (LCP) materials. Such a system will be designed in the Phase I program based on our eight year experience in process and application development in both lyotropic and thermotropic LCP materials. Our design will integrate the use of a new impermeable LCP liner material, low thermal conductivity LCP fittings and struts, and a new high strength damage resistant LCP fiber overwrap. Key to the success of fabricating the LCP cryogenic tank system in Phase II will be a design based on demonstrated and proven fabrication and processing technologies for all components in the system. Our experience encompasses all of the required processing and fabrication technologies with the exception of forming a seamless lyotropic LCP tank liner or diaphragm. Accordingly, the proposed Phase I program will include a demonstration of a new innovative approach to forming this complex shape with polybenzoxazole (PBO) film. With this process demonstration we can confidently do a realistic cost, weight, and mission profile analysis of the Phase I design and deliver it at the conclusion of the Phase I program. The detail cryogenic tank system design along with this analysis and the confidence gained with the PCO complex shape process demonstration, all accomplished in Phase I, will assure a sound Phase II program for the fabrication and test of a prototype system.

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Topic#: 92-077 ID#: 92PL3-054  
Office: PL/OLAC  
Contract #: F29601-92-C-0073  
PI: DEBORAH TUOHY

Title: Structural Resin Transfer Molding of Thermotropic Liquid Crystal Polymers for Solid Rocket Motor Case Applications

Abstract: Foster-Miller proposes to develop a structural resin transfer molding (SRTM) process for thermotropic liquid crystal polymers (TLCPs) using innovative proceeding techniques. Development of our proposed processing technology will enable the use of TLCPs as matrix materials for composites and result in a low-cost, reliable automated manufacturing process for medium to large size solid rocket motor (SRM) cases. TLCPs are an ideal resin matrix system for applications because of their high strength, light weight, high fracture toughness, thermal resistance, good charring characteristics and excellent ablation properties. Candidate TLCPs include vectra, xydar, and hx4000. TLCPs cannot be melt processed for SRTM applications because of their high melt viscosity (10,000 poise). RTM processing typically requires viscosities of 2 to 6 poise. However, Foster-Miller's unique processing technology can deliver tlcp's to an SRTM process and provide complete saturation of a braided preform reinforcement. Foster-Miller will develop a novel SRTM mold to make a cylindrical SRM demonstration article in Phase I. The mold will have innovative filling and consolidation means to provide compressive forces during the composite molding process. The combination of SRTM mold design and TLCP processing innovations will ensure that the SRM demonstration article has high fiber volume (50 to 60%) and a low void content (<2%).

## AIR FORCE SBIR PHASE I AWARDS

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Topic#: 92-098  
Office: BMO/MYSP  
Contract #:  
PI: DAVID H. WALKER

ID#: 92PL6-034

Title: The Use of Alternative Refrigerants for Missile Guidance Cooling Systems

Abstract: The U.S. Air Force is presently preparing plans for the phase out of atmospheric ozone depleting substances, such as CFC and HCFC refrigerants. One of the more difficult applications to address is the cooling components associated with guided missile weapon systems, which presently employ either CFC-12 or HCFC-22. Finding suitable zero ODP substitute refrigerants for these applications is particularly difficult, because much of the cooling is unique to guided missiles and the hardware is integral to the entire weapons system. Alternate refrigerants must be employed in a fashion that minimizes the need for alteration to this hardware, while still meeting design cooling requirements. Leading candidate refrigerants that have little or no impact on atmospheric ozone include HFC's and refrigerant blends of HFC's and HCFC's. The proposed project will examine the specific requirements of each cooling system and determine the alternate refrigerant that can be employed with minimal hardware change. System modifications will be identified that will ensure proper performance. Testing of the refrigerants will be undertaken to verify that the design approach will produce the desired end results.

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Topic#: 92-121  
Office: WL/FIOP  
Contract #: F33615-92G-3207  
PI: RAMAKRISHNA IYER

ID#: 92WL4-045

Title: Innovative Ferromagnetic Sensors/Instrumentation To Monitor Aircraft Aging

Abstract: Current operational metal aircraft are getting older and newer ones use more composite materials. The design of both the current and new aircraft is based on a damage tolerant philosophy. This implies that the aircraft should sustain the regulatory fail-safe loads in the presence of defeats, until detected through inspection or malfunction. Present NDE techniques typically require grounding of the aircraft, which affect their operational readiness. These NDE techniques essentially require teardown which sometimes induces defects in the aircraft structure. Defects such as fatigue cracks and delaminations are frequent. The concept proposed consists of tagging the aircraft structure magnetostructure particles, which will generate signatures in the structure during development of fatigue cracks/delaminations. The concept will render the aircraft not only sensible but also smart.

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Topic#: 92-156  
Office: ASD/XXR  
Contract #:  
PI: RAMAKRISHNA IYER

ID#: 92XXR-026

Title: SMART, Reusable and Adaptive Inserts for Aircraft Fasteners

Abstract: A typical aircraft requires extensive amounts of fasteners. Due to the harsh environment to which those fasteners are subjected locking systems for threaded connections are seriously critical to aircraft integrity. The most challenging environmental issue is the temperature range (-65F to +800F) in which the thread locking system must perform. Aircraft of mid-twentieth century design relied heavily on mechanical locking techniques, such as lockwires and castellated nuts, but the skill and time required for proper installation is excessive. Later, locking nuts fitted with nylon patches or rings were developed, however the inherent problems of limited temperature range and low reusability have not been surmounted. Likewise, all-metal self-locking nuts have serious shortcomings, such as limited vibration resistance and mechanical thread destruction. The proposed effort employs shape memory alloy (SMA) as the locking mechanism. By cleverly exploiting the recovery of SMA to its original form, adaptive locking mechanisms can be developed that provide extensive allowable reuse, a greatly enhanced temperature range, and superior locking force for improved vibration damping.

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Topic#: 92-032  
Office: ESD  
Contract #: F19628-92-C-0141  
PI: EDWARD P. JORDAN

ID#: 92ES2-072

## AIR FORCE SBIR PHASE I AWARDS

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**Title: TACC Imbedded Training (ESD)**

**Abstract:** Effective employment of air power requires both planning and skillful management of current (ongoing) operations. Operational-echelon tactical air commanders and their staffs at the tactical air control centers (TACCS) require simple, top-level wargaming tools for deliberate planning and contingency planning; for decision aiding during the execution of an air campaign; and for generating air directives, air tasking orders, and commanders' briefings quickly and accurately. Frontier proposes in Phase I to define and design a TACC wargame for training in a specified user environment to implement the design during Phase II and in Phase II to develop and implement derivative aids for tacc planning, decision making, and generation of orders and briefings.

GENERAL SCIENCES, INC.  
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NORRISTOWN, PA 19403  
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Topic#: 92-125 ID#: 92WLS-003  
Office: WL/MLIP  
Contract #: F33615-92-C-5946  
PI: PAUL JUNEAU

**Title: Advanced Heat Shield Materials**

**Abstract:** This proposal describes the efforts required to study the effects of various materials on the reduction of electronic interface in the plasma of a re-entry vehicle heat shield. A fundamental understanding of the mechanism by means of which these materials achieve a reduction in electronic interference is the goal of the proposed investigations, in which the GSI flame test apparatus is used to determine initial characteristics, followed by an elucidation of mechanisms of material behavior at elevated temperatures.

GLOBAL INFORMATION SYSTEMS TECHNOLOGY  
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Topic#: 92-029 ID#: 92AL -091  
Office: AL  
Contract #: F41624-92-C-5004  
PI: DR. THOMAS T. CHEN

**Title: Re-Usable Instructional Strategy Segment Templates for Highly-Efficient Computer Based Training Development and Delivery**

**Abstract:** The Air Force has been using computer-based training for more than 20 years, yet it still confronts many of the same basic problems: subject matter experts are usually not instructional designers, instructional designers are usually not programmers, CBT courseware is expensive to develop (typically 400 hours per hour of deliverable training), and courseware design is rarely supported by validated instructional theory. Global proposes to develop reusable and modifiable instructional-strategy templates for efficient creation of effective cbt courseware. Unlike existing efforts in this area, which employ a top-down approach (e.g., a strategy for teaching a "problem solving" task), global will use a bottom-up methodology for selecting, validating, and implementing instructional strategy segments. The bottom-up approach involves studying existing courseware that already works well, selecting lesson segments that would be useful across many domains and that would be labor-intensive to code, ensuring that the strategies are instructionally sound, generalizing the strategies, and creating strategy segment templates each with a customized authoring interface. We expect use of these templates to reduce CBT design/development time to 100 hours per hour of deliverable training.

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CHATSWORTH, CA 91311  
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Topic#: 92-079 ID#: 92PL3-064  
Office: PL/OLAC  
Contract #: F29601-92-C-0074  
PI: DR. ALAN S. HERSH

**Title: Lightweight, Compact Noise Source.**

**Abstract:** A research program is proposed to demonstrate the feasibility of a company proprietary lightweight, compact sound source concept to generate the high intensity, high frequency controlled sound pressures required in experimental investigations of combustion instability in liquid rocket engines. The proposed work plan is divided into three principal parts. The first is to select the most promising design. The second is to build a working prototype of the design. The third is to conduct basic tests to verify the feasibility of the design.

## AIR FORCE SBIR PHASE I AWARDS

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HNC, INC.  
5501 OBERLIN DRIVE  
SAN DIEGO, CA 92121  
Phone: (619) 546-8877  
Title: Automated Librarian

Topic#: 92-044 ID#: 92ES3-059  
Office: RL  
Contract #: F30602-92-C-0106  
PI: STEPHEN I. GALLANT, PH.D.

Abstract: HNC has developed an automated mechanism for indexing and retrieving free text documents called document retrieval using meaning (DRUM). DRUM is based on context vectors that encode a representation of the meaning of documents. This HNC proprietary approach was chosen for funding by DARPA as PM of the tipstek text detection and extraction program. DRUM is able to: \* Perform free text database document retrieval and routing. \* Adaptively refine context search parameters using relevance feedback. \* Provide automatic system generation capabilities and an easy-to-use query interface. \* Allow easy expansion to domain specific topic areas. The darpa prototype system addresses the solicitation requirements of free text retrieval and dynamic adaptation, and has been demonstrated on text corpora of over 10,000 documents. However, this system needs to be enhanced to address the requirements of automatic indexing, cataloging, and summarization. HNC proposes to address these enhancements by extending the existing DKUM system to include automatic index term generation and automatic summarization of documents. Both capabilities can be easily integrated into the existing darpa system. The proposed approach will provide the Air Force with a high performance system at low technical risk.

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Topic#: 92-152 ID#: 92XRX-071  
Office: ASD/XRX  
Contract #:  
PI: TODD W. GUTSCHOW

Title: Multifusion: A New Approach to Mobile Target Identification

Abstract: The problem of reliably detecting and correctly classifying mobile targets is an unsolved problem of great military significance. In this project, HNC will apply its new multifusion approach to multiple sensor fusion and a priori knowledge exploitation to the problem of mobile target detection. The multifusion approach utilizes neural networks to carry out pre-classification feature extraction and attribute derivation for each type of sensor product employed. A priori knowledge concerning the targets and the rules for their use is pre-coded into a belief combination network. After extracting the features and attributes from each of the sensor output is completed, they are entered into the belief combination network to carry out fusion. The output of the belief combination network is a determination of the likelihood that the object being considered is a mobile target. HNC's multifusion approach is unique in that it combines classical neural network pattern classification methods with rule-based methods in a single unified structure. Another advantage of the multifusion approach is that it is computationally efficient and will support on-board real time processing in both missiles and aircraft. We anticipate that this powerful new approach will provide significantly increased capability for mobile target detection and classification.

HORIZONS TECHNOLOGY, INC.  
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BILLERICA, MA 01821  
Phone: (508) 663-6600

Topic#: 92-010 ID#: 92CEL-094  
Office: AFCEA  
Contract #: F08635-92-C0065  
PI: EUGENE L. ANDERSON

Title: Masking Hardened Aircraft Shelter Door Radar and Infrared Signatures

Abstract: Horizons Technology, Inc. (HTI) proposes to examine current and developing masking technologies in the microwave, infrared and visual spectral regions to design a camouflage system which can be applied to 3rd generation hardened aircraft shelters in the european and pacific theaters. The research effort will focus on developing a series of approaches to signature reduction of the steel framework, doors and aprons of the shelters, costing those efforts and, through various modeling techniques, verifying the efficacy of the proposed approaches. Through compatibility analysis, HTI intends to optimize the mixture of approaches derived and recommend a primary design. Phase I will review existing and developing technology, create a full compatible design meeting the unique structure requirements, and analyze the feasibility of the recommended design. Phase II will provide design verification through component testing, modeling applications and full scale prototype field testing; all leading to a design acceptable for service-wide application.

## AIR FORCE SBIR PHASE I AWARDS

HYPRES, INC.

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Phone: (914) 592 1190

Topic#: 92-048

Office: RL

Contract #: F19628-92-C-0125

PI: SERGEY RYLOV

ID#: 92ES3-102

Title: High Performance Superconducting Flux-Quantizing A/D Converters Using Multibit Differential Code Front End & RSFQ Logic Based Decimation Filter

Abstract: Hypres proposes a program to research, develop and demonstrate a new class of high-performance superconducting AD converters (ADCs) based on counting single magnetic flux quanta, high-speed differential coding, and decimation filtering. The ADCs will maintain a unique bandwidth-to-accuracy trade-off ratio of 1.5 effective bits per factor of 2 bandwidth (bw) reduction (instead of the usual 1 bit). This improvement is due to an ultrafast decimation filter using recently developed rapid single flux quantum (RSFQ) logic/memory elements capable of 100 GHz operation. The program goal is to replace the simple 2-bit quantizer front end of the adc with a multi-bit soid wheel design, yielding 3 extra bits of resolution for the same bandwidth. The proposed adcs are expected to achieve 16.5 effective bits at 50 MHz bw or 1.5 effective bits at 50 GHz bw. These ADCs have both small area and low-power dissipation, therefore many channels can be implemented on a single substrate. Multiple channels can be synchronized by a single 100 GHz clock. In Phase I, we will complete the analysis of this class of ADCs and demonstrate its key components operating at multi-ghz clock frequencies. In Phase II, we will produce a working prototype ADC.

IBIS TECHNOLOGY CORP.

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Phone: (508) 777-4247

Topic#: 92-128

Office: WL/MLIP

Contract #: F33615-92-C-5941

PI: DR. L. ALLEN

ID#: 92WL5-074

Title: Non-Destructive Characterization of Simox SOI Forparametric Optimization

Abstract: The built-in buried oxide in Simox silicon-on-insulator (SOI) material has promoted recent advances in aerospace, radiation-hardened, high temperature, smart power, and sensor circuit applications. The quality of the silicon layer after implantation and a method for non-destructive testing are of keen interest for the manufacturing and quality control of the product. Recent SOI results using a non-destructive, five crystal monochromator x-ray diffraction system indicates a sufficient range of rocking curve full widths at half maximum (FWHM) for correlation to quantitative silicon defect density measurements. The latter are obtained with destructive chemical etching and microscopic analysis. An opportunity is presented to develop the correlation of the destructive defect etching technique to the non-destructive FWHM rocking curve measurements for a quantitative quality control tool in Simox SOI manufacturing. The improvement is predicted to reduce the fabrication cost through the non-destructive nature of analysis and play a key role in Simox SOI material optimization.

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Topic#: 92-069

Office: PL/XPPP

Contract #: F29601-92-C-0070

PI: MICHAEL S. WALKER

ID#: 92PL1-073

Title: Shielded High Temperature Superconductor Interconnect Technology for Packaging High Speed Cryoelectronic Systems

Abstract: A prototype high temperature superconductor (HTS) packaging system for high speed cryoelectronic circuits will be built, tested, and delivered. The circuits are expected to be hybrids of semiconductor and superconductor components which are incorporated in a package which will have exceptional high frequency performance, be secure from high frequency interference, and provide minimum electromagnetic radiation leakage. Its technology, because of the exceptionally low surface impedance of superconductors and the absence of skin effects, can provide critical improvements in electronic packaging, especially in the 100 MHz to 10 GHz range. Also, cryogenic operation increases circuit speeds, improves silicon thermal conductivity, and leads to a thousand-fold drop in leakage currents. The tentative package design calls for an appropriate substrate which is backed by a multi-layered ybco structure - patterned to form signal interconnects - and into which silicon chips are inserted. A polyamide strip, 1 mil-thick, is placed on top of the signal interconnects and topped, in turn, with a HTS shield. The Phase I objectives are the design of an optimum package architecture and the demonstration of the critical technology required for the fabrication of a manufacturable multi-layer structure composed of appropriately dimensioned YBCo films and low dielectric constant insulators. It is anticipated that a complete prototype package will be constructed in Phase II.

## AIR FORCE SBIR PHASE I AWARDS

INNOVATIVE TEST SYSTEMS  
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Topic#: 92-094 ID#: 92PI.6-015  
Office: BMO/MYSP  
Contract #:  
PI: RICHARD HILEMAN

Title: Integrated Pin Diode Transmit/Receive Switching for ICBM Communications

Abstract: This project explores an innovative implementation of pin diodes for high power transmit/receive switches in survivable ICBM communications systems. The proposed concept integrates the switches within the high power amplifier and facilitates transmit/receive switching at greatly reduced power levels. Pin diode transmit/receive switches are commonly used in VHF and uhf communication systems, however, the high transmit power levels and nuclear weapons environment have precluded their use in survivable ICBM applications. As a result, current developments and deployments require separate transmit and receive antennas. The proposed implementation will circumvent these problems and permit reliable high power operation with a single antenna. The proposal research is based upon the high output impedance levels exhibited by the SICBM high power amplifier during receive. This high impedance level will result in a simplified switch design and an increased tolerance of the post-attack communications system to any device degradations.

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Topic#: 92-007 ID#: 92CEI.027  
Office: AFCESA  
Contract #:  
PI: DR ZHENYU ZHANG

Title: Development of a Selective Sensor for Organic Contaminants in Groundwater Using A Molecular Imprinting Technique

Abstract: The widespread presence of chlorinated and nonchlorinated organics in groundwater at many Air Force sites poses a serious environmental and health problem, with particular attention being drawn to trichloroethylene (TCE) as a common carcinogenic contaminant. Currently, monitoring the tce contaminant level in groundwater typically comprises the collection of samples at the site, transportation of the samples to an analytic laboratory, and subsequent analysis in the laboratory. Such a procedure is labor-intensive, expensive, and time-consuming. In addition, the analysis only gives one concentration data point in time and space, with the chance that the removal and transportation of the sample may have altered its chemical composition. We propose to use a molecular imprinting technique to prepare a TCE-sensitive polystyrene film and to apply it to a surface acoustic wave (SAW) device to detect and quantify the tce concentrations in groundwater. A TCE-sensitive SAW microsensor will provide a highly sensitive, low-cost, on-line and real-time means for monitoring TCE in ground water.

INTELLIGENT AUTOMATION, INC.  
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ROCKVILLE, MD 20850  
Phone: (301) 990-2407

Topic#: 92-012 ID#: 92CEI.127  
Office: AFCESA  
Contract #: F08635-92-C0071  
PI: LEONARD S. HAYNES

Title: Vehicle Navigation Using 3D Camera

Abstract: An autonomous airfield repair vehicle (ARV) will need to be able to navigate through an area to perform repair operations on runways and taxiways. In order to simplify use, it is imperative that only the onboard sensors and memory resident topographical map be used for this navigation. Intelligent Automation, INC., Has developed the concept for a three dimensional camera which will give a full range map of the scene as seen by the camera at a rate of 60 frames per second. Our initial experiments show that we will be able to obtain an accuracy of less than 1 inch over a range of 100 feet from the camera, which is far better than the 1/2 foot requirement of the ARV. The full, accurate range image produced at 60 frames per second make the problem of navigating based on a topographical map a trivial application of image matching algorithms. Using very conventional transformation matrices, the topographical map can be transformed to a range map of distances from the last known position of the camera. This is then compared to the range image produced by the camera, and the differences used to compute the new position of the camera. The process is iterative, and will converge very rapidly. We estimate the time to compute the camera's position to be no more than 1/15 second. The key is that the image we are capturing with our camera is not a conventional intensity image, but a full, accurate range map giving the range to every point in the scene. The information in the range image is the same type of information as is in the topographical map, hence the problem reduces to one of simple pattern matching.

## AIR FORCE SBIR PHASE I AWARDS

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BOSTON, MA 02111  
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Topic#: 92-090 ID#: 92PL6-084  
Office: BMO/MYSP  
Contract #:  
PI: DR. FARIBORZ MASEEH

Title: Innovative Guidance & Navigation Sensors and Processing

Abstract: A development program for a low-cost, smart, miniature, lightweight, self-contained, and stand-alone navigation system (referred to as SNS) is proposed. SNS uses novel miniature inertial navigation system (INS) and a low-cost global positioning system (GPS) for position initialization. Our proposed ins component uses novel silicon microsensors with on-chip functionality (smart microsensors) such as a micro-resonating gyroscope (MRG). The sensors' output are interfaced to a microprocessor where Kalman filtering and computations are performed to determine position and velocity as a function of time. The objectives of Phase I are: (1) to characterize the constituents of SNS including sensors, GPS, and interface electronics, (2) to optimize the design of a novel monolithic micromachine the gyroscope's package. The results of Phase I will be used to build and commercialize an SNS in Phase II and III in collaboration with the existing independent potential partnerships. The resulting SNS will be several times lighter, less expensive, and smaller than any existing navigation system with similar performance characteristics.

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Topic#: 92-149 ID#: 92WL4-091  
Office: WL/XPK  
Contract #: F33615-92C-3610  
PI: Larry Lafferty

Title: Development of Descriptive Methods for Verification and Validation Testing of Associate Systems

Abstract: Associate systems, as complex integrated human-machine systems, pose difficult problems for verification and validation testing. Traditional emphases on analysis or statistical hypothesis testing are not powerful enough to effectively test such systems. The most promising approaches to verification and validation testing or associate systems are descriptive methods using interpretive analysis. These approaches are methodologically immature, creating a major obstacle to their exploitation. This innovative research proposal will develop descriptive methods for verification and validation testing using the Pilot's Associate as an example system. The anticipated result will be a preliminary design for a software tool to conduct efficient and repeatable interpretive analysis of associate systems.

KDC TECHNOLOGY CORP.  
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Topic#: 92-128 ID#: 92WL5-228  
Office: WL/MLIP  
Contract #: F33615-92-C-5940  
PI: RAY J. KING

Title: Nondestructive Evaluation of Moisture in Composites Using Microwaves

Abstract: The broad objective of this exploratory research is to demonstrate the feasibility of using innovative microwave sensors to nondestructively evaluate and monitor moisture which has diffused into nonconducting fiber reinforced cured composite structures and matrix preregs. In cured composites, moisture causes the matrix to swell and soften with a subsequent loss of stiffness and strength. It induces residual swelling strains and microcracking, and irreversibly degrades the fiber/matrix interface. In repair, moisture diffuses into the repair adhesive to cause deterioration and blistering. In uncured preregs, moisture slows the formation of the polymer network and increases the viscosity and void content. Preliminary microwave tests have shown that diffused moisture has a pronounced effect on the macroscopic dielectric properties of composites. Using an innovative sensor design, the bulk effects of both the real dielectric constant and the loss factor have been shown to provide two independent effects of diffused moisture. From such independent measurements, it appears possible to quantify the cumulative moisture and to even make some assessment of the moisture in the boundary layer which often occurs following transient exposure and drying cycles. Specific tasks focus on sensor design, their optimization and use, monitoring moisture diffusion into cured composites and preregs, and modeling of the diffusion process for correlation of moisture profiles with the microwave measurements.

## AIR FORCE SBIR PHASE I AWARDS

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Topic#: 92-101 ID#: 92WL2-025  
Office: WL/AAOP  
Contract #: F33615-92-C-1059  
PI: ERIC HORVITZ

Title: Decision-Theoretic Approaches to Sensor Management

Abstract: Knowledge industries will explore problems with real-time sensor management, with a focus on formal probabilistic and decision-theoretic methods for reasoning under uncertainty. From the perspective of decision analysis, we view sensor management as including two key components: (1) assignment of probabilities to competing explanations, given current sensor data; and (2) determining which sensor, or sensor suite, should be employed next to resolve the current uncertainty. For the probability-assignment problem we will investigate the feasibility of employing probabilistic causal networks call them belief networks} to model the relationships among important variables for tactical Air Force aircraft operations. Specifically, we will research models containing different mixes of discrete and continuous variables, and investigate how different contexts and time-dependencies can best be handled. For the sensor selection problem, we will explore the use of alternate methods for reasoning about the value of information. In particular, we will examine the use of information theory, decision theory, and methods that combine the formal approaches with heuristic control methodologies. For the probability assignment and sensor selection problems, we will evaluate alternative approaches with respect to computational efficiency, quality of decisions, ease of model construction, and model maintenance. Finally, we will examine requirements for a Phase II evaluation and implementation.

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Topic#: 92-129 ID#: 92WL5-136  
Office: WL/MLIP  
Contract #: F33615-92-C-5953  
PI: DR. M.B. SPITZER

Title: Feasibility of Gainp/GaAs Quantum Well IR Detectors

Abstract: This proposal addresses the nation's need for improved infra-red detectors and detector arrays. In Phase I, we propose to investigate the feasibility of improving multi-quantum well AlGaAs/GaAs superlattice detectors, by replacing the AlGaAs by GaInP. The greater band gap discontinuities in the GaInP/GaAs system, as well as the absence of Al, may yield enhanced performance. Phase I work will be limited to establishing the basic feasibility of the approach. In Phase II of this work, superlattice detectors will be formed and evaluated. Phase III comprises commercialization of the technology.

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Topic#: 92-031 ID#: 92ES2-036  
Office: ESD  
Contract #: F196280-2-C-0150  
PI: ILYA SCHILLER

Title: Pilot Adaptable Optimal Planning (POP)

Abstract: This feasibility effort will demonstrate neural network-based (NN) automated route planning for aircraft, adaptable to the user's flight preferences and mission needs. This system, termed pilot adaptable optimal planning (POP), will be designed to operate in two modes. In the first mode it will provide the means for route planning and estimating the success of the user's route plan by flying and training the simulated missions. The user will pretrain missions for general requirements with flight patterns corresponding to the user's individual preferences. These missions will be collected in mission specific libraries. In the second mode, the user will select an appropriate mission from the library and optimize it to the desired mission using the latest intelligence, maps, weather, etc. This will achieve two goals: (1) introduce pilot flight preferences into reroute planning and (2) provide optimization of route plans. The plan can be evaluated in monte carlo simulation, with scoring indicating the probability of a successful mission. In our vision, the proposed pop system would eventually be implemented on an a mission planning workstation like MASSE II and MASSE III where it may enhance current route optimization process.

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Topic#: 92-103 ID#: 92WL2-038  
Office: WL/AAOP  
Contract #: F33615-92-C-1060  
PI: DR. D.C. GERSTENBERGER



## AIR FORCE SBIR PHASE I AWARDS

Title: Continuous Wave Single-frequency 1.5 um to 5 um Optical Parametric Oscillators

Abstract: this program will investigate continuous-wave optical parametric oscillators (OPOs) in the 1.5 to 5 um spectral range as tunable sources suitable for coherent laser radar. Diode-pumped CW single-frequency Nd:YAG lasers operating at 1.064 um will be used as pump sources. The Phase I effort will consider potassium titanyl phosphate (KTP) and periodically-poled lithium niobate as possible materials for OPOs. Phase I will include experimental determination of the optical losses of KTP crystals near 2 um, measurement of the parametric gain for 2 UM light in ktp using a diode-pumped, high power, CW single-frequency 1.064 um pump laser and design of an OPO using ktp. Phase I will also estimate the performance of periodically-poled lithium niobate (required periodicity of domain reversal, parametric gain, tunability) as an OPO in this spectral region.

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Topic#: 92-152 ID#: 92XRX-053  
Office: ASD/XXR  
Contract #:  
PI: DR SRINEVASAN RAGHAVEN

Title: An Object-Image Alignment Approach to Object-Oriented Target Recognition

Abstract: Object-oriented methodologies such as model-based vision provide a robust and more intelligent solution to the ATR problem. Because these methodologies exploit a priori knowledge of a limited number of target models, while allowing the targets to be oriented towards the viewer in any arbitrary fashion, they result in a powerful ATR system. The central focus of this proposal is on building an automatic target recognition system for identifying mobile targets using an object-image alignment approach. Using this approach, we propose to develop a two stage recognition algorithm. The first stage of this algorithm makes use of the three-point object-image correspondence theorem of Huttenlocher and Ullman (1990) to narrow the search for constrained matching of object-image pairs. The second stage of the algorithm uses the mean-field annealing technique to compute the object-image transformation parameters from multiple matches by minimizing a least-squares measure. For segmentation of the target from its background, we employ a motion-based segmentation algorithm developed earlier by LNK.

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Topic#: 92-141 ID#: 92WL6-030  
Office: WL/POMX  
Contract #: F33615-92-C-2241  
PI: BRYAN J. SEEGER

Title: Preliminary Design of a Smart Actuator for Aircraft Turbine Engines

Abstract: Proposes to conduct preliminary design and analysis of a "smart actuator" for application on aircraft gas turbine engines. For this proposal, a smart actuator is defined as one that is co-packaged with an electronics module that provides control signal compensation and control loop closure directly at the source. A typical actuator would consist of the following: (1) electric, hydraulic or pneumatic movement or force generator. (2) Electronic micro-controller. (3) Feedback mechanism for control loop closure. (4) Electronic/fiber-optic interfacing device. (5) Control, feedback and self-diagnosis software algorithms. The following would be accomplished during Phase I: (1) basic research to accurately establish operational requirements of a typical gas turbine actuator. (2) Basic research to identify latest advances in high temperature micro-electronic and fiber-optic technology. (3) Preliminary design of an autonomous, co-packaged actuator system incorporating high temperature electronic and fiber-optic technology. (4) Preliminary development of software algorithms for feedback, sensory input compensation and self-test. (5) Development of a program and cost estimate for Phase II.

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Topic#: 92-005 ID#: 92AFD-036  
Office: AEDC  
Contract #:  
PI: DR MOSHE LAVID

Title: Real-Time Subsonic Flow Vector Measurement

Abstract: We propose to employ a new non-intrusive optical technique to measure instantaneous three dimensional flow vectors in large scale subsonic facilities with high (better than mach .02) accuracy. The method utilized a pulsed laser beam to "write" an arbitrary pattern into ordinary air by means of stimulated raman vibrational excitation. After suitable time delay, during which time the induced pattern convects with the flow, the new position is determined by induced fluorescence from a second

## AIR FORCE SBIR PHASE I AWARDS

laser beam. An image of the displacement is captured with a video camera. By writing a grid, or similar pattern, simultaneous vectors from multiple spatial locations within the flow field can be determined. The accuracy of the measurement is limited only by the ability to determine time and displacement, and can be performed at vector update rates of 30 Hz using readily available commercial equipment. The measurement can be performed in any flow containing oxygen. In this effort we propose a detailed study, including appropriate laboratory proof-of-concept measurements, of the applicability of the technique to subsonic flow. The development of an inherently accurate time-of-flight method, without the requirement of particle seeding, constitutes a unique new capability for large scale facilities, where seeding is a difficult problem. The result of this effort will be a detailed design of a prototype system for implementation in aedc facilities.

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Topic#: 92-151 ID#: 92XRX-048  
Office: ASD/XRX  
Contract #:  
PI: MICHAEL D. SHUTAK

Title: Cost Methodology for Premilestone I Planning

Abstract: The Air Force requires a premilestone I cost methodology to assess the costs for emerging technologies in the areas of advanced avionics and integrated avionics architecture; high performance turbine engines and other innovative propulsion systems; and high temperature materials with different properties. This methodology will provide the approaches needed to estimate the costs of the specific technologies and their impact on the total new weapon system/subsystem cost modeling in comparison to the estimated differences in operational effectiveness. The proposed effort will develop cost model modules for the emerging technologies to assess their impact on the conceptual alternatives. The cost model modules will be based on engineering insight into the advanced technologies. Using engineering insight with sound engineering fundamentals, the individual cost model modules will provide accurate, dependable results. These cost modules will be incorporated into a total weapon system model which will accept operational inputs for a complete assessment of the new weapon system/subsystem. The cost model modules and the total weapon system model will be compatible with IBM PC applications. Results from the emerging technology cost modules will be used to define a database that can be incorporated into a larger aircraft systems database.

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Topic#: 92-124 ID#: 92WL5-148  
Office: WL/MLIP  
Contract #: F33615-92-C-5945  
PI: ALAN WESLEY MOOREHEAD

Title: Direct Fluorination Technology: The Synthesis of Perfluoropolyalkylether Fluids Using Liquid Phase Direct Fluorination  
Abstract: This proposal outlines research into the feasibility of the production of perfluoropolyalkylether fluids, with a variety of molecular structures, using the technique of dynamic flow direct fluorination in the liquid phase. This would involve the surface fluorination of rapidly stirred (ca. 3500 r.p.m.), neat ether, and polyether liquids over a range of temperatures (-78 to 100 C). This represents a significant departure from the existing direct fluorination methods of perfluoropolyalkylether production in that the starting material is not a solid, but a liquid. To accomplish this, a liquid phase reactor which will enable the rapid, even dispersal of elemental fluorine into the reaction mixture must be constructed. The products obtained in the subsequent experiments will be analyzed using spectroscopic methods and elemental analysis.

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Topic#: 92-035 ID#: 92ES2-115  
Office: ESD  
Contract #: F19628-92-C-0129  
PI: CHARLES S. SIMERLY

Title: Command, Control, Communications, Countermeasures (C3CM) Measure of Effectiveness Concept and Decision Making Tool

Abstract: In modern warfighting theory, a command, control, communications and countermeasures (C3CM) strategy should be used to employ operations security, deception (exploitation), jamming and destructive means against an adversary. A creditable concept on how to measure the warfighting benefits of a comprehensive C3CM strategy is needed. The incorporation of such a concept into an existing decision aid tool could greatly enhance the use of these strategies. Phase I will develop a

## AIR FORCE SBIR PHASE I AWARDS

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concept and design for an automated mapping/targeting aid system for measuring the effectiveness of C3CM warfighting strategies. Phase II develop an automated mapping/targeting aid system and demonstrate its application to various C3CM scenarios.

MATERIALS & ELECTROCHEMICAL RESEARCH  
7960 SOUTH KOLB ROAD  
TUCSON, AZ 85706  
Phone: (602) 574-1980

Topic#: 92-073 ID#: 92PL1-929  
Office: PL/XPPP  
Contract #: F29601-92-C-0039  
PI: RAOUF O. LOUTFY

Title: Advanced Hydrogen Electrode for High Performance Ni/H<sub>2</sub> Secondary Batteries

Abstract: A novel and newly discovered C60 carbon material was found to exhibit unique electrochemical and physical properties. C60 and catalyzed C60 electrodes will be fabricated by vapor deposition and dry pressing. These electrodes will be fully characterized for hydrogen reduction in various aqueous electrolytes. The nature of the electrochemical hydrogenation of C60 will be established. A single cell with Ni-C60(Hx) will also be characterized including its self-discharge behavior, to establish the viability of this system as a secondary battery for aerospace applications, and the viability of C60(Hx) electrodes for fuel cell systems.

MATERIALS ANALYSIS, INC.  
10338 MILLER ROAD  
DALLAS, TX 75238  
Phone: (214) 343-3811

Topic#: 92-156 ID#: 92XRX-052  
Office: ASD/XRX  
Contract #:  
PI: JAMIE L. PETTY-GALIS

Title: Superior Fiber Inserts for Nuts

Abstract: The objective of this Phase I investigation is to develop candidate designs for a prototype prevailing torque nut with a locking mechanism that can be reliable re-used. The current prevailing torque nuts used in military aircraft are a nuisance in the respect that they will provide adequate locking for only one installation. This "single-use" criterion requires the maintenance of adequate stocks of spare lock nuts. Elimination of the single-use limitation of the nuts utilizing fiber inserts would reduce fastener inventory requirements as well as eliminate the risk of mission readiness. Successful completion of this Phase I effort will provide a design prototype nut with a recoverable locking capability for flight test and concept validation during Phase II investigations.

MDA ENGINEERING, INC.  
500 E. BORDER STREET, SUITE 401  
ARLINGTON, TX 76010  
Phone: (817) 860-666

Topic#: 92-157 ID#: 92WLO-027  
Office: WL/MNPB  
Contract #: FO8630-92-C-0042  
PI: RALPH NOACK

Title: An Efficient Hybrid Grid Scheme for Calculation of Viscous Flows

Abstract: A hybrid grid scheme which utilizes automatically generated structured meshes glued together by unstructured meshes is proposed for development. The hybrid method promises to combine the ease and low man-hour requirement for the generation of unstructured meshes with the efficiency of the viscous flow solver on structured meshes. Thus the hybrid scheme will combine the advantages of the two meshes with minimal degradation in performance. We propose the development of an efficient hybrid grid scheme for use in obtaining viscous CFD solutions. The goal is to develop a balanced set of grid generation and flow solver codes which will reduce the person hours required to generate the grid with only a modest increase in computer execution times for the flow solver. The proposed approach is to generate structured grids near the surface of the geometry and use unstructured grids to glue these structured grids together. This approach will allow the flow solver to execute at optimal efficiency on the structured portion of the grid. The hybrid grid can be generated in an automated fashion without requiring significant user expertise or time. This will allow the CFD analysis capability to be placed in the hands of engineers without requiring them to be CFD experts.

MEMRY TECHNOLOGIES, INC.  
57 COMMERCE DRIVE  
BROOKFIELD, CT 06804

Topic#: 92-156 ID#: 92XRX-042  
Office: ASD/XRX  
Contract #:

## AIR FORCE SBIR PHASE I AWARDS

Phone: (203) 740-7311

PI: L. MACDONALD CHETKY

Title: Superior Fiber Inserts for Nuts

Abstract: A variety of polymers are used as inserts in nuts to provide resistance to loosening from vibration and shock. Fiber reinforced resins formerly used have generally been replaced with polyamides (nylon) and polyamides. It would be a logistics advantage if these prevailing torque lock nuts could be reused after they have been demated from their bolt or shaft during inspection or repair procedures. Although some manufacturers of the smaller self locking nuts claim that these items can be roused up to 50 times, military procedures require that nuts be discarded after demating; this is particularly true of precision nuts used as retainer and preload devices for bearings. Recently introduced shape memory plastics (SMP) have a dramatic change in modulus when heated above their glass transition temperature (tg), and a deformed part will recover its original shape when heated above this temperature. Shape memory polymers may thus provide the necessary mechanical features to serve as elastomeric locking elements in nuts of these types, while making possible the recovery of the virgin dimensions of the insert upon heat treatment after demating. Evaluation of selected SMPS will be carried out in both their pure form and modified by fillers to establish their torque characteristics and their reusability.

METSAT, INC.

Topic#: 92-088

ID#: 93PL1-015

515 S. HOWES STREET

Office: PL

FORT COLLINS, CO 80521

Contract #: F04701-93-C-0005

Phone: (303) 221-5420

PI: DONALD L. REINKE

Title: New High-Resolution Cloud Climatology Products From Meteorological Satellites

Abstract: This Phase I SBIR will investigate the feasibility of producing reliable High-Resolution Satellite Cloud Climatologies (HRSCC's) from meteorological satellite imagery. There is currently NO DOD HRSCC database which meets the requirements for medium and long-range cloud forecasts. The HRSCC's show the frequency of occurrence of cloud cover, spatial distribution of clouds, and cloud cover amount, and can be stratified by cloud type and cloud height. They are produced from both archived and real-time data streams, and are produced exclusively from satellite imagery. Phase I will determine how HRSCC's can be produced from the USAF Defense Meteorological Satellite Program (DMSP) digital imagery and will demonstrate how these new products can be applied to meet USAF operational requirements. These new high-resolution cloud products are unique, and rely on innovative image processing techniques to make use of current technology meteorological satellite imagery. We will demonstrate how HRSCC's can serve as both an assessment and forecast tool. We believe this type of product has the potential to become standard cloud climatology reference for DoD. There is excellent potential for long term product development with applications for both the DOD and civilian operations that are impacted by clouds.

MICROTRONICS ASSOC., INC.

Topic#: 92-017

ID#: 92AFO-039

4516 HENRY STREET, STE 403

Office: AFOSR

PITTSBURGH, PA 15213

Contract #: F49620-92-C-0038

Phone: (412) 681-0888

PI: DR M. H. FRANCOMBE

Title: Rare Earth Doped III-V Semiconductors for Optoelectronics

Abstract: The project will focus on developing procedures for the fabrication and evaluation of epitaxial layers of III-V compound semiconductors which are doped with rare earth (RE) ions. The re ions are to be incorporated in a 3+ valency such that efficient intraatomic (4f-4f) transitions can be observed. The doped material is to be fabricated via metal-organic vapor deposition (MOCVD). Qualitative and quantitative evaluations are to be performed via luminescence measurements, deep level transient spectroscopy and mobility and resistivity measurements. In Phase I we shall concentrate our efforts on establishing the growth parameter for erbium doped GaAs and AlGaAs in terms of optimal V/III ratio, growth temperature and er doping concentrations. The optical evaluations will play a role in establishing the identification of the lattice site of the incorporated RE ion. Simultaneously, we shall explore and identify appropriate device structures which allow us to exploit the material for light emitting diodes, laser diodes or an integrated switch-with-amplifier. Also, and evaluation of other RE ions, such as Nd, PR, YB, shall be performed with respect to their potential and desirability as light emitters as well as to the availability of suitable precursors for their use in MOCVD fabrication.

## AIR FORCE SBIR PHASE I AWARDS

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MISSION RESEARCH CORP.  
1720 RANDOLPH ROAD, SE  
ALBUQUERQUE, NM 87106  
Phone: (505) 768-7649

Title: Fractal Modeling of Spall Characteristics

Abstract: Models for fragmentation and debris modeling have heretofore been largely empirical and ad hoc. It is proposed here to develop a model for fragmentation with a firm theoretical basis. This model will be based upon the demonstrated fractal properties of fracture.

Topic#: 92-060 ID#: 92PL2-046  
Office: PL/XPPP  
Contract #: F29601-92-C-0026  
PI: LOUIS BAKER

MISSION RESEARCH CORP.  
735 STATE STREET, P.O. DRAWER 719  
SANTA BARBARA, CA 93102  
Phone: (703) 339-6500

Title: Diagnostic Tools for Characterizing Electromagnetic Impulse Radiation Fields

Abstract: Electromagnetic pulses having rise and fall times as short as 10 ps and pulse durations from 100 ps to 10 ns are useful for Air Force applications ranging from impulse radar to ultrawideband (UWB) weapon systems. In order to develop these systems and evaluate their effectiveness, it is essential to be able to measure single pulses having bandwidths up to 30 GHz in a nonperturbing manner. At present there is no satisfactory technique for characterizing such pulses in a free radiation field. We propose to solve the problem by utilizing novel electro-optic techniques made possible by recent advances in the fashioning of nanostructures from optical materials and in the development of new lasers and pulsed-laser diagnostics.

Topic#: 92-064 ID#: 92PL2-084  
Office: PL/XPPP  
Contract #: F29601-92-C-0031  
PI: DR. RICHARD SMITH

MOLTEN SALT TECHNOLOGY, INC.  
1704 CLIFTGATE ROAD  
KNOXVILLE, TN 37909  
Phone: (615) 774-3141

Title: High Rate Thermal Battery for Space Applications

Abstract: Feasibility of a thermal cell lithium/sulfur(IV) in an  $AlCl_3^*/LiCl$  melt will be investigated. This cell is related to the rechargeable sodium/sulfur(IV) battery system involving the molten  $AlCl_3^*/NaCl$  melt and the  $\beta$ -alumina separator. A solid lithium alloy anode will be substituted for molten sodium to prevent melting upon activation and to increase the energy density while the  $\beta$ -alumina separator will be replaced with a thin layer of a solid lithium electrolyte. Cell prototypes will be designed, built and tested during the Phase I program as a proof of concept. The Phase I program will not include devices for thermal activation, however, provisions will be made to incorporate such devices into complete cell units to be tested in the Phase II of the program.

Topic#: 92-139 ID#: 92WL6-060  
Office: WL/POMX  
Contract #: F33615-92-C-2245  
PI: DR GLEB MAMANTOV

MRJ, INC.  
10455 WHITE GRANITE DRIVE, SUITE 200  
OAKTON, VA 22124  
Phone: (703) 934-9268

Title: The Application of Concept Space to the Automated Librarian

Abstract: The availability of massive data storage and high-speed information gathering systems aggravates the existing problem of processing and correlating the data. Indeed, the processing and correlation requirements exceed the capabilities of both human librarians and "first-generation" software. The information overload raises national-security concerns where such information-handling systems support time-critical decision making in defense and law enforcement. MRJ proposes to respond to the information overload with the refinement of our "second-generation" computer software librarian. Our solution uses concept space defined in the text to produce a more capable system for document retrieval and indexing. MRJ has a current independent research and development (IR&D) project that will develop the basic tools to create and manipulate concept space. This proposed Small Business Innovative Research effort will develop the specific software tools to apply concept space to the automated librarian problem. The completion of the task will include a software demonstration and a report on our analyses. We also propose to produce a plan for evolving the demonstration software into the Phase II effort.

Topic#: 92-044 ID#: 92ES3-075  
Office: RL  
Contract #: F30602-92-C-0110  
PI: MARK J. ROSENBAUM

## AIR FORCE SBIR PHASE I AWARDS

MSNW, INC.  
P. O. BOX 865  
SAN MARCOS, CA 92079  
Phone: (619) 489-9471

Topic#: 92-045 ID#: 92ES3-081  
Office: RL  
Contract #: F19628-92-C-0146  
PI: DR. GEORGE H. REYNOLDS

Title: Phosphorus Purification

Abstract: The Phase I research will examine a simplified purification scheme for s and for Si contaminated p precursors. The process uses chemical techniques as well as low temperature fractional distillation to effect separation of high purity PH3 and to minimize contamination from container materials + the degree of purification achieved by sequential distillation steps and the degree of interaction with candidate containment materials will be determined analytically and a demonstration quantity of material produced.

MSNW, INC.  
P.O. BOX 865  
SAN MARCOS, CA 92079  
Phone: (619) 489-9471

Topic#: 92-123 ID#: 92WL5-082  
Office: WL/MLIP  
Contract #: F33615-92-C-5950  
PI: DR. GEORGE H. REYNOLDS

Title: Protective Coatings for Polymer Matrix Composites

Abstract: The Phase I research will examine novel methods for application of single phase and composite glass and glass-matrix coatings for oxidation and erosion resistance improvement of AFR700B matrix composites. Single phase and composite coatings will be applied to composite substrates by sol-gel, solution/melt processing, and by low power thermal spraying techniques. Coating microstructures will be fully characterized and coating oxidation properties measured at appropriate temperatures. The developed methods of single phase and composite glass coating preparation are expected to be useful for cost-effective application of oxidation and erosion control coatings on advanced aircraft structures and components.

MSNW, INC.  
P.O. BOX 865  
SAN MARCOS, CA 92079  
Phone: (619) 489-9471

Topic#: 92-126 ID#: 92WL5-098  
Office: WL/MLIP  
Contract #: F33615-92-C-5938  
PI: DR. GEORGE H. REYNOLDS

Title: Analysis and Demonstration of Coating Concepts for SiC Monofilaments

Abstract: The proposed research will conduct both thermochemical and thermomechanical analyses of candidate internal and external coating materials and configurations for SiC monofilaments. Analyses will consider single and duplex coatings to be deployed in a range of titanium alloy and titanium intermetallic matrices. Selected examples of promising coating concepts will be experimentally prepared and supplied to ongoing wl-sponsored programs for independent evaluation.

MTL SYSTEMS, INC.  
3481 DAYTON-XENIA RD.  
DAYTON, OH 45431  
Phone: (513) 426-3111

Topic#: 92-105 ID#: 92WL2-066  
Office: WL/AAOP  
Contract #: F33615-92-C-1064  
PI: ROBERT F. METZ

Title: Improved Real-Time Simulation of Antenna Effects "Improved Real-Time Antenna Modelling System (IRAMS)"

Abstract: The objective of this program is to accomplish the preliminary design for, and establish the feasibility of, an innovative real-time antenna modeling system (IRAMS). MTL proposes a system which will employ proven and predictable existing simulation algorithms and signal modulation devices for the computational and modulational subsystems of the IRAMS. The effort will focus upon design and verification of a paradigm which will employ three levels of algorithms: rigorous, empirical, and lookup tables, interactively and efficiently in both the support (non-real-time) and runtime (real-time) elements of the computational subsystem. The modulation subsystem will employ devices known to function in this application based upon previous successful applications. A demonstration will be conducted to confirm the accuracy and execution speed performance of both subsystems, in prototype host facility, the Integrated Defensive Avionics Laboratory (IDAL), WL/AAWA-2, Wright-Patterson AFB, Ohio. The Phase I product will be a preliminary design, simulated and tested to ensure functionality and demonstrated to establish feasibility. This will provide a solid and quantified basis for system implementation, integration into the host facility, and database population, in the Phase II effort.

## AIR FORCE SBIR PHASE I AWARDS

MTL SYSTEMS, INC.  
3481 DAYTON-XENIA ROAD  
DAYTON, OH 45431  
Phone: (513) 426-3111

Topic#: 92-110 ID#: 92WL3-039  
Office: WL/ELA  
Contract #: F33615-92-C-1058  
PI: Praveen Chawla

Title: Very-High-Speed Integrated Circuit Hardware Design Language (VHDL) Behavioral Simulation Acceleration Engine  
Abstract: MTL proposes to perform the preliminary design for a very high speed integrated circuit hardware design language (VHDL) behavioral simulation acceleration engine, and to demonstrate the critical aspects of that design through simulation. The approach will be to use the QUEST parallel simulation technology developed at the University of Cincinnati which currently executes on a general purpose distributed processor architecture to greatly speed up simulation execution. Data obtained through instrumentation of the QUEST simulator will be used to identify the necessary computer architecture, including memory structures, general-purpose and coprocessor execution units, input/output architecture, inter- and intra-networks, host interfacing, systems software, and application software necessary to significantly accelerate VHDL simulation over that possible even in general aspects purpose parallel computers. As a part of design effort, critical aspects of the design will be identified, simulated, tested and demonstrated to ensure a low-risk high-performance implantation of IEEE/ANSI 1076 VHDL simulation. High-performance implementation of the IEEE/ANSI 1076 VHDL simulation.

MTL SYSTEMS, INC.  
3481 DAYTON-XENIA ROAD  
DAYTON, OH 45431  
Phone: (513) 426-3111

Topic#: 92-148 ID#: 92WL7-019  
Office: WL/XPK  
Contract #:  
PI: John H. Harshbarger

Title: Automatic Brightness Control for Cockpit Electronic Display Instruments  
Abstract: MTL System, INC. proposes to develop a methodology for automatic compensation of cockpit electronic display devices suitable to the display technology, cockpit environment, and in full consideration of the human factors which impact upon display visibility. This methodology will be demonstrated at a breadboard level with video equipment on hand. Significant aspects of this program include: human factors analysis to define required control characteristics; development of 'breadboard' software and hardware to create atypical display compensation stimulus; demonstration of correction in a mock cockpit setup. The objective of this effort as proposed is to create Automatic Display Cockpit Control as opposed to merely Automatic Brightness Control which may not render an electronic display optimally visible under all conditions to be encountered. The Phase I program will conclude with rationale and preparations made for construction of prototype systems as specified for a Phase II effort.

NEOMECS, INC.  
4832 PARK GLEN ROAD  
ST LOUIS PARK, MN 55416  
Phone: (612) 927-7223

Topic#: 92-027 ID#: 92AL -158  
Office: AL  
Contract #: F41624-92-C-9002  
PI: HIROSHI NOMURA

Title: Development of Membrane Sampling System to Concentrate Toxic Environmental Compounds for Raman Spectroscopy Analysis  
Abstract: In the longer term, the results of this research could lead to improved methods and equipment for sampling, concentrating and analyzing traces of hazardous chemicals in groundwater. Specific objectives: 1) Prepare hollow fiber membranes by surface modification. 2) Assemble membrane modules. 3) Test modules for permeability to selected pesticides in water solution. 4) Select appropriate solvents for extracting pesticides from feed water by means of membrane modules. 5) Measure concentrations of pesticides in samples of extraction solvent using surface enhanced raman scattering (SERS). 6) Verify concentration factors in the membrane enriching system.

NETROLOGIC, INC.  
5200 SPRINGFIELD AVE, SUITE 312  
DAYTON, OH 45431  
Phone: (513) 253-1558

Topic#: 92-144 ID#: 92WL6-133  
Office: WL/POMX  
Contract #: F33615-92-C-2229  
PI: JAMES R. JOHNSON

Title: Methodology for Turbine Engine Lubrication Sensitivity Analysis  
Abstract: Under this program the current and planned lubrication system design approaches for advanced gas turbine engines

## AIR FORCE SBIR PHASE I AWARDS

such as those being developed under the integrated high performance turbine engine technology (IHPTET) initiative will be reviewed, the available lubrication system performance data will be assembled, and the projected mission profiles such as intercept, combat patrol, close air support or tactical transport and the associated major engine classes expected for these missions will be identified. Additionally, the capability of available engine cycle decks to incorporate lubrication system performance data and to be implemented on a personal computer will be assessed. Using the gathered data, an engine cycle deck will be selected and the fundamental lubrication system models and algorithms for liquid, powder and even unlubricated systems will be identified. Finally, a plan will be prepared for the development and implementation of a gas turbine engine lubrication system performance assessment software resource that can operate on a personal computer.

### OPHIR CORP.

10184 WEST BELLEVIEW AVE, SUITE 200  
LITTLETON, CO 80112  
Phone: (303) 933-2200

Topic#: 92-118

ID#: 92WL4-027

Office: WL/FICP

Contract #: F33615-92C-3609

PI: DR DAVID C MACPHERSON

Title: A True Airspeed Indicator Based on Doppler Shifted Molecular Laser Backscatter

Abstract: An investigation of two methods of using doppler shifted molecular backscatter to measure an aircraft's true airspeed is proposed. Because aerosol backscatter at high altitude is so small, its usefulness in measuring airspeed is seriously doubtful. Quantum-line resonant (non-rayleigh) molecular backscatter on the other hand is several orders of magnitude stronger. The first method we propose would use gas correlation spectroscopy to detect a small doppler shift in a broad Co2 emission line. This method does not require spatial or temporal coherence between the emitted light and received signal. The second method we propose for measuring molecular doppler shift is to count zero crossings in a return signal after it has been heterodyned with a reference laser beam. This method has the potential for making very accurate aircraft true airspeed measurements. The proposed effort will investigate the relative advantages of these two techniques. This investigation will consider the realistic interferences from fog, cloud and other weather-related effects. A preliminary Phase II proof-of-feasibility hardware design will be completed for the superior technique.

### OPTICOMP CORP.

PO BOX 10779, 215 ELKS POINT RD  
ZEPHYR COVE, NV 89448  
Phone: (702) 588-4176

Topic#: 92-052

ID#: 92ES3-161

Office: RL

Contract #: F30602-92-C-0112

PI: PETER S. GUILFOYLE

Title: Supercomputer Data/Knowledge Bases

Abstract: Solicitation AF92-052 requires an investigation and design of an appropriate mechanism for developing large supercomputer data/knowledge bases. Opticomp corporation proposes to implement a limited set of data/knowledge base algorithms on a digital opto-electronic computer currently being integrated under Rome Laboratory/ONR contract N00017-89-C-0266. The architecture of the digital optical computer (DOC II) will be capable of performing; 3 comprehensive set of full text data knowledge base operations. The data input rate of DOC II is 12.8 Gbits per second. The machine is designed to provide 10e12 binary operations per second. ASCII equality detection, for example, which is the algorithm used for text search, will run at 51.2 billion compares per second. Most data/knowledge based operations require searching a significant number of documents to retrieve and process only a few pages or data vectors. In the proposed configuration, textual data are stored on optical disks, retrieved - n parallel, and processed "on-the-fly" by the optical computer. Only data that satisfy a particular query are converted into electronic signals and transferred to the end-user. A combination of two-dimensional spatial light modulators and photodetectors are used for array processing. In this way, the system takes full advantage of the speed and parallelism of digital optical technology.

### OPTRA, INC.

66 CHERRY HILL DRIVE  
BEVERLY, MA 01915  
Phone: (508) 921-2100

Topic#: 92-022

ID#: 92AL -133

Office: AL

Contract #: F41624-92-C-6003

PI: ANDREW LINTZ

Title: Magneto-Optic Gravity Induced Loss of Consciousness

Abstract: The proposed program will begin the development of a new magneto-encephalogram (MEG) sensor applicable to the detection of gravity induced loss of consciousness (G-LOC) in fighter pilots. Optra will apply several recently developed



## AIR FORCE SBIR PHASE I AWARDS

technologies to measure the small fluctuating magnetic fields produced by normal and unconscious brain activity. The new magnetometer uses the field strength dependent faraday rotation of an optical beam as a transducer, and singlemode fiber optic interconnections to produce a compact, all dielectric sensor head that could be easily incorporated into a pilot's helmet. By combining advanced engineered materials with high verdet coefficient, high power laser diode sources and Opira's high resolution phase measurement techniques, a sensor system with 10-13t resolution is possible. The measurement would be linear over 140 dB so changes in background magnetic fields would not affect the sensitivity. The sensor could be configured in first and second order gradient configurations. The sensor operates at room temperature and requires no cryogenics as does the alternative magnetic sensing technology (squid).

ORBITAL TECHNOLOGIES CORP.  
402 GAMMON PLACE, SUITE 10  
MADISON, WI 53719  
Phone: (608) 833-1992

Topic#: 92-074 ID#: 92PL3-074  
Office: PL/OLAC  
Contract #: F29601-92-C-0071  
PI: DR. ERIC RICE

Title: Prototype storage and delivery device for cryogenic solid oxygen propellants.

Abstract: Orbital Tech proposes to develop a means to produce and utilize solid oxidizers in a combustion chamber. Condensation gaseous oxygen directly to the solid state appears an intractable approach because of low density of the frost formation. Rapid freezing from the liquid phase however, assures a dense, coherent solid phase formation. To simplify delivery to the combustion chamber, we propose to use the combustion chamber as the freezing and storage compartment. Cryogenics other than hydrogen and helium have negligible vapor pressures at the temperatures indicated, and sublimation rates would be negligibly slow. We propose to accomplish the oxidizer solidification by means of an LH2 chilled heat sink and to control the rate of condensation by the delivery pressure of the oxygen/ozone mixture. In operation, the engine would operate as a liquid/solid hybrid motor. Gaseous or liquid fuel, such as hydrogen or methane would be pressure fed into the solid oxidizer grain which had been formed in place in the motor case. During Phase I we will demonstrate the condensation and freeze process. During Phase II, we will build and fire a small motor in the 100-200 lb thrust range.

ORINCON CORP.  
9363 TOWNE CENTRE DRIVE  
SAN DIEGO, CA 92121  
Phone: (619) 455-5530

Topic#: 92-031 ID#: 92ES2-023  
Office: ES2  
Contract #: F19628-93-C-0004  
PI: Dr. Robert N. Lobbia

Title: Command, Control and Communications Systems/Subsystems

Abstract: Air defense Systems of distributed ground and airborne tracking radars are beset with problems when fusing track data at a central command site. This occurs when one or more of the tracking radars produces a track scene with component track offsets (or biases) from the true target location by a constant amount. The offsets are created by a number of mechanisms, including imprecise knowledge of the radar's absolute location and electromagnetic (EM) propagation anomalies such as ducting. The result is that two track scenes from different radar sites will be incorrectly fused if the track offsets are not properly accounted for. This proposal will attempt to circumvent these problems by using a novel approach called "noncooperative target sensor registration" (NCTSR). This is in contrast to the cooperative target sensor registration (CTSR) algorithms in existence today. The technical approach is a two step problem. First, a track scene-to-scene matching is performed using an optimal assignment algorithm (like Munkres') to identify common targets in the two track scenes. Next, the track pairs that pertain to common targets are passed through another optimization procedure to generate the offset state vector to correct the tracks. This approach has the virtue of operating on the actual targets that are present -- it does not rely on scheduling a known and cooperating target to fly calibrated trajectories for it to operate properly. Thus, it is possible to obtain near continual updates on the radar track offsets without having to expend considerable resources to compute these offsets. The bottom-line is we obtain more accurate track scenes when performing data fusion in a distributed sensor environment.

PAI RESEARCH, LTD.  
5202 WESTLAND BOULEVARD  
BALTIMORE, MD 21117  
Phone: (410) 455-6310

Topic#: 92-166 ID#: 92WL0-048  
Office: WL/MNPB  
Contract #: FO8630-92-C-0036  
PI: DR. VENCATESH R. PAI VERN

Title: Laser Diode Initiation of Primary Explosives

## AIR FORCE SBIR PHASE I AWARDS

**Abstract:** It is well documented that primary explosives like  $\text{Pb}(\text{N}_3)_2$  can be initiated (detonated) by high level laser pulses. The high power of the lasers is required because the laser power is utilized to initiate  $\text{Pb}(\text{N}_3)_2$  - only indirectly. The ir and near ir radiation of the laser is absorbed by  $\text{PbNaB}$  or  $\text{Pb}(\text{N}_3)_2$  blended with carbon black giving rise to vibrational excitation which, in turn, results in thermal energy which finally initiates  $\text{Pb}(\text{N}_3)_2$ . The initiation of  $\text{Pb}(\text{N}_3)_2$  has also been accomplished by radiation of wave-lengths 347 microns and 265 microns by direct photoexcitation of the azide ion. However, the radiations 347 microns and 265 microns have been obtained from ruby and nd lasers indirectly by frequency doubling from visible and frequency quadrupling from ir respectively resulting in very low efficiency. The objective of this proposal is to modify  $\text{Pb}(\text{N}_3)_2$  at a molecular level so that low level laser pulse can initiate  $\text{Pb}(\text{N}_3)_2$  directly by photoexcitation. Our unique approach is to move the electronic excitation region of  $\text{Pb}(\text{N}_3)_2$  crystals (powder), at a molecular level, with 10-2 - 10-1 weight percent colored dopants like red  $\text{Fe}(\text{N}_3)_3$ , red  $\text{PbCr}_2\text{O}_7$  and black brown  $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$ .

PAQ COMMUNICATIONS  
607 SHETLAND COURT  
MILPITAS, CA 95035  
Phone: (408) 946-3305

Topic#: 92-031 ID#: 92ES2-002  
Office: ESD  
Contract #: F19628-92-C0139  
PI: QUYEN D. HUA

Title: Ionospheric Scintillation Monitoring for C3I

**Abstract:** Various DOD C3I communications systems can be seriously affected by the disturbances in the earth's ionosphere. One way to alleviate this problem is to use alternate C3I assets during the times of predicted signal outages due to ionospheric scintillation fading. However, current prediction technique based on monthly climatology of ionospheric fading does not provide real-time solutions. Past experiments using signals broadcast from the navstar global positioning system (GPS) satellites to measure amplitude and phase scintillation in real time have been successful. But the cost of these gps receivers is very high rendering them impractical to be deployed in large number in a theatre battlefield environment. A very inexpensive ionospheric scintillation monitor (ISM) based on state-of-the-art high-performance commercial GPS receiver is proposed. Phase I effort will produce a prototype ISM capable of measuring, in real time, the amplitude scintillation index and the phase jitter. Detrending algorithms to remove the effects of receiver oscillator phase noise and GPS selective availability will be developed and experimented during Phase I.

PARADIGM, INC.  
2605-A RAMBLE ROAD  
BLACKSBURG, VA 24060  
Phone: (703) 953-2041

Topic#: 92-161 ID#: 92WLO-148  
Office: WL/MNPB  
Contract #: FO8630-92-C-0026  
PI: LIANG, CHEN, PH.D.

Title: Adaptive Composite Hydraulic Cylinders With Embedded Shape Memory Alloys Fibers

**Abstract:** Hydraulic componentry for aircraft bomb rack and missile launcher systems requiring very high hydraulic pressures are being developed, however, typically the component weight is high and there is a strong desire to investigate methods to reduce the total weight. Components made of composites and hybrids are desirable options in order to reduce weight and therefore maximize aircraft fuel efficiency and speed. This proposed effort utilizes a new and innovative approach to lightweight pressure devices, based on shape memory alloy hybrid composites. Shape memory alloy (SMA) hybrid composites are a class of composites which contain embedded sma fibers which can act as internal actuators to resist the tensile stresses caused by internal pressure. If SMA is used on the exterior of a thin-walled pressure device, and electric current is passed through the sma actuators, the SMA will create a compressive force within the material. This return force is adequate to counteract the hoop stress of the thin-walled pressure device. The resulting hybrid composite thin-walled vessel with sma actuators is significantly lighter than all-composite vessels or monolithic metallic vessels.

PARKE MATHEMATICAL LABORATORIES  
L RIVER ROAD P.O. BOX 811  
CARLISLE, MA 01741  
Phone: (508) 369-3818

Topic#: 92-045 ID#: 92ES3-077  
Office: RL  
Contract #: F19628-92-C-0135  
PI: DR. ALTON F. ARMINGTON

Title: Phosphorus Purification for High Speed INP Circuit Technology

**Abstract:** The use of phosphorus for the growth of III-V and other electro-optic materials requires a higher purity than presently available commercially. This proposal outlines possible procedures to improve phosphorus purity either as an element or through

## AIR FORCE SBIR PHASE I AWARDS

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the use of an intermediate. It is believed that the purity can be improved by an order of magnitude.

PECHT ASSOC., INC.  
4407 BEECHWOOD RD.  
HYATTSVILLE, MD 20782  
Phone: (301) 927-4567

Topic#: 92-099  
Office: BMO/MYSP  
Contract #:  
PI: JUDY PECHT

ID#: 92PL6-016

Title: New Reliability Model Varying The Dormancy Factor

Abstract: The purpose of this project is to develop a user-friendly, microcomputer-based reliability/logistic model for utilization in determining potential spare parts requirements, considering the dormancy factor. Our approach will produce a single average time-to-failure statistic for each part analyzed by the model. The statistic will represent an average of the total population of each part and can be used as a surrogate mtbf statistic in other models used for reliability or logistics. Our model will dynamically apply both dormancy and operating life environmental data to compute average time-to-failure. A software prototype focusing on microelectronic components will be developed for demonstration in Phase I. Populating the model with actual part data, upgrading the model to accommodate recommendations from the Phase I model, and demonstrating the operational model to necessary Air Force personnel will be actions during Phase II.

PHASEX CORP.  
287 EMERSON ROAD  
LEXINGTON, MA 02173  
Phone: (508) 794-8686

Topic#: 92-016  
Office: AFOSR  
Contract #: F49620-92-C-0036  
PI: MICHAEL P. COFFEY

ID#: 92AFO-041

Title: Improved Oxidation Resistance Of 3-D Carbon/Carbon Composites

Abstract: The coating of carbon fibers with silicon carbide offers enhanced oxidation resistance for carbon/carbon composites. Research to form a thin, uniform, coherent layer on fibers in a tow, tape, or 3-D preform is described. The research involves the use of an advanced polycarbosilane polymer which can be converted to silicon carbide. Supercritical fluids will be used to dissolve the precursor polymer. A supercritical solution, because of its advantageous transport and surface tension properties, can penetrate microchannels such as those in a tightly packed tow, tape, or 3-D preform. Deposition conditions to produce the thin coating will be developed. After coating, the polymer will be cross-linked and paralyse to silicon carbide, and oxidation resistance of coated carbon fibers or preforms will be measured and compared to uncoated carbon fibers or preforms. As a means of assessing the value of the Phase II effort, and economic viability evaluation of the process for improved coated carbon fibers will be made on the Phase I program.

PHOTONICS, INC.  
423 RIGHTERS MILL ROAD  
GLADWYNE, PA 19035  
Phone: (215) 896-2178

Topic#: 92-179  
Office: ASD/NAF  
Contract #: F33657-92-C-2111  
PI: DR. M. A. EL-SHERIF

ID#: 92WL9-040

Title: A Novel Sapphire-Fiberoptic Sensor for High Temperature Testing of Composite Turbine Engine

Abstract: A comprehensive research study, leading to the development of a novel sapphire-fiberoptic sensor, for high temperature testing of composite turbine engines in "real" environments, is proposed. The sensor will operate on the principle of modal power distribution (MPD) modulation in multimode sapphire fibers caused by thermal and mechanical stresses in the smart materials. The strategy for the proposed research is to use the mpd in a special coated sapphire multimode optical fiber as a sensitive tool, in high temperature environment, for measurements of smart structural response of various modes of perturbation. This technique will be applied for sensing these perturbations by comparative measurements of modal power distribution and subsequent redistribution at the output end of the fiber. A preliminary investigation was carried out successfully in the last year, through the SBIR Phase I of the Army contract # DAA104-91-C-0011, using a silica fiber embedded in low temperature composite. The results indicate that this developed technique is highly sensitive and well suited for smart structure applications. To optimize the sensor configuration for high temperature composites, an extensive study of coated sapphire fiber will be investigated, using special coated multimode sapphire fiber. The Phase I work will include the design and fabrication of protectively-coated sapphire optical waveguide that can withstand high temperature without cracking or chemical degradation. The optical fiber will be embedded the material and tested to prove the concept of using the mpd technique with embedded sapphire fiber.

## AIR FORCE SBIR PHASE I AWARDS

PHYSICAL OPTICS CORP.  
20600 GRAMERCY PLACE, SUITE 103  
TORRANCE, CA 90501  
Phone: (310) 320-3088

Topic#: 92-001  
Office: AEDC  
Contract #:  
PI: DR SHUDONG WU

ID#: 92AED-012

Title: Fiber-Optic Spectrophotometry to Measure Turbojet Exhaust-Soot Particle-Size Distribution Function

Abstract: The present work deals with the design, development, testing and implementation of a real-time monitoring system to determine the particle size distribution of soot. The novel technique shall make use of multiwavelength analysis of light scattering properties of the particles to infer the particle index of refraction, the soot number density and the particle size distribution. The Phase I technical objectives are the following: a) Investigate the feasibility of using multiwavelength light scattering and extinction properties of sooting flows from which the size distribution of soot can be inferred; b) Determine the particle dynamic range of the proposed instrument, sensitivity, and limitations as applied to the specific application; c) Investigate the relative merits of using a single laser, i.e., an Argon-ion, as opposed to three different lines with widely spaced wavelengths; d) Develop a breadboard system from which preliminary measurements of soot can be measured from a laboratory scale flame. The effort shall consist of using three different wavelengths of laser light to obtain the light scattering and extinction from soot particles to infer the complex index of refraction of soot, its concentration, and the particle size distribution. The use of solid state diode lasers and photodiodes shall be incorporated in the novel instrument to obtain a compact probe to be used in typical combustion environments.

PHYSICAL OPTICS CORP.  
20600 GRAMERCY PLACE, SUITE 10  
TORRANCE, CA 90501  
Phone: (310) 320-3088

Topic#: 92-020  
Office: AL  
Contract #: F41624-92-C-6002  
PI: ROBERT A. LIEBERMAN

ID#: 92AL -134

Title: Dual Purpose Fiber Optic Sensor for Monitoring Aircraft Oxygen Systems

Abstract: The ability of crewmembers to operate effectively and safely is continuously being tested as aerospace vehicles attain faster speeds, higher altitudes, and higher g environments. The crewmembers' breathing apparatus or molecular sieve oxygen generating system (MSOGS) is of primary importance. However, no sensors are available that can measure oxygen concentration and flow rate safely, between the regulator and the crewmember's mask, in a flight test environment. We propose a fiber optic sensor that can measure both oxygen concentration and flow rate safely and reliably. The proposed oxygen concentration sensor utilizes porous optical fibers and gas specific indicator dyes. The proposed flow rate sensor uses a length of commercially available fiber held taught across the gas flow. Vibrations induced in the optical fiber, which are directly related to the flow rate, are monitored optically via a change in speckle pattern, or interferometrically. A Phase II prototype would involve combining both of these sensing techniques into a single optical fiber sensor.

PHYSICAL OPTICS CORP.  
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TORRANCE, CA 90501  
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Topic#: 92-031  
Office: ESD  
Contract #: F19628-92-C-0128  
PI: EVA STRZELECKI

ID#: 92ES2-061

Title: Wavelength Multiplexed Multi-Hop Communications Networks With High Throughput and Fault-Tolerant Capability

Abstract: The tremendous bandwidth of optical fibers has led to their use in optical telecommunications and local area networks (LAN). Time division multiplexing (TDM) and code division multiplexing (CDM) are both restricted by electronics and electrooptics, which limit the throughput to less than 20 gb/s. Wavelength division multiplexing (WDM) allows high level of concurrency between users and could potentially achieve 1tb/s network throughput. However, implementation of a large number of wavelength multiplexed channels is presently both costly and difficult because of technological problems with tunable laser diodes and filters. New architectures based on multi-hop networks that combine parallel processing with efficient packet switched lans can achieve a high level of concurrency with very few technological breakthroughs. Physical Optics Corp. proposes to combine a multi-hop network architecture with wavelength multiplexed wavelengths and yet can achieve high throughput. The network is fault tolerant, due to its redundant paths. In the Phase I program the operation of the wavelength multiplexed multi-hop network will be studied. A demonstration of signal transmission using wdm components will support our theoretical studies.

## AIR FORCE SBIR PHASE I AWARDS

PHYSICAL OPTICS CORP.  
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Topic#: 92-170 ID#: 92WLO-124  
Office: WL/MNPB  
Contract #: FO8630-92-C-0024  
PI: DR. FREDDIE LIN

Title: A Laser Doppler Velocimeter With Range and Directional Grating Capabilities

Abstract: Current methods for predicting the effects of wind on projectile trajectories are limited, because these methods assume a homogeneous wind vector. Actual wind patterns are inhomogeneous in terms of both direction and range. To solve these problems, Physical Optics Corporation (POC) proposes a novel LDV design, based on a combination of POC's unique multiplexed holographic optical elements (HOES) and confocal imaging/focusing optics. The unique advantage of POC's approach is that it can measure the entire 3d wind velocity while simultaneously performing measurements in many directions and ranges. POC's proposed device represents both a range and directional gated LDV that provides a sampled profile of the 3-D components of wind velocity along the beam path, so that relative target velocity with respect to platform can be measured. The read-out subsystem gives real-time output suitable for calculating perturbations on projectile trajectories. System range can be at least 2.5 Km, and the optical subsystem is compact and efficient. The success of this research will introduce new capabilities in LDVs for wind velocity vector measurements at multiple ranges and will also find applications in fluid mechanics research, measurement of supersonic velocities, laser doppler anemometers and many other sensing and probing applications.

PHYSICAL OPTICS CORP.  
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Phone: (310) 320-3088

Topic#: 92-174 ID#: 92WLO-172  
Office: WL/MNPB  
Contract #: FO8630-92-C-0025  
PI: LEV SADOVNIK

Title: Rugged Elastooptic Polymer Fiber Optic Pressure Sensor for Penetration Munition Fuzing

Abstract: Advanced fuzing mechanisms based on hydrostatic pressure and deceleration are necessary to successfully detonate a warhead after penetrating through a multiple-layer military structure. Conventional fuzing mechanisms detonate on impact, which only damages the outer most layers of a military structure. Physical Optics Corporation proposes the use of an intrinsic elasto-optic fiber optic pressure sensor, based on aliphatic polymers, for warhead fuzing. The pressure sensor monitors the transmission of optical power through a pressure sensitive optical fiber. When the optical power changes by a specified amount (corresponding to a predetermined pressure), the sensor will initiate warhead detonation. The pressure level at which the sensor activates the warhead can be selected by changing optical fiber material and fiber orientation.

PHYSICAL SCIENCES, INC.  
20 NEW ENGLAND BUSINESS CENTER  
ANDOVER, MA 01810  
Phone: (703) 548-6410

Topic#: 92-019 ID#: 92AFO-007  
Office: AFOSR  
Contract #: F49620-92-C-0034  
PI: DR DAVID OPIE

Title: Compact Active Hydrogen Maser

Abstract: PSI proposes to test the feasibility of an active compact hydrogen maser oscillator. Recent advances in high temperature superconductors make possible the realization of microwave resonant cavities with high quality factors and only 2% of the volume of those used in existing masers. The resulting reduction in size and weight of hydrogen masers is critical to their application in space systems such as GPS. This superconducting resonator has already been constructed and tested. It is a compact loop-gap design and has a quality factor that is more than 3 times larger than a copper version of the resonator measured at the same temperature and frequency. It has been shown that the frequency stability of a compact active maser operating at 77K has the same or better fundamental limit of frequency fluctuations, due to thermal fluctuations within the hyperfine linewidth. Calculations show that if this level is reached (and not limited by systematic fluctuations), the stability will be better than 1 part in 10x15 at 2000 seconds (allan deviation). In Phase I, we will complete the tests and investigations necessary to design the proposed oscillating maser.

PHYSICAL SCIENCES, INC.  
20 NEW ENGLAND BUSINESS CTR  
ANDOVER, MA 01810

Topic#: 92-062 ID#: 92PL2-064  
Office: PL/XPPP  
Contract #: F29601-92-C-, 29

## AIR FORCE SBIR PHASE I AWARDS

Phone: (508) 689-0003

PI: PETER E. NEBOLSINE

Title: Instrumentation for Hypervelocity Particle Impacts

Abstract: The proposed Phase I program will produce a design of a holographic system to measure the location, cross-sections and the velocities of particles via double exposure. This holographic technique has already been demonstrated in the ordnance velocity regime and is ready for application of hypervelocity kinetic energy and orbital debris experiments. Physical sciences inc and the University of Alabama in huntsville are a complimentary team in the area of diagnostics, ballistic range capabilities, experimental planning of hyper-velocity experiments, and data reduction and analysis. The results of the Phase I design effort will be implemented in the Phase II program. The design envisions an impact flash triggered and delayed double pulse holographic capture of the debris field. Multiple particle impacts can be studied by the suitable delay and pulsing of the laser system as well as the ability of the holographic process to discern the precise location of the fragments.

PHYSICAL SCIENCES, INC.  
20 NEW ENGLAND BUSINESS CENTER  
ANDOVER, MA 01810  
Phone: (508) 689-0003

Topic#: 92-091 ID#: 92PL6-059  
Office: BMO/MYSP  
Contract #:  
PI: MICHAEL L. FINSON

Title: Reentry Turbulent Plasma Modulation Model

Abstract: Physical Sciences Inc. (PSI) proposes to develop a model and computer code to predict and analyze the effects of turbulent boundary layer plasma modulation on antenna performance. A theory for the electromagnetic propagation of microwave radiation through a turbulent medium will be developed to provide amplitude and phase modulation information. This theory will be analogous to existing methods for optical propagation through turbulence, but will be specialized to conditions where the electromagnetic wavelength is much longer than scale sizes of the plasma fluctuations. PSI further proposes to extend its existing hypersonic turbulent boundary layer model to provide the plasma statistical parameters that influence propagation. In Phase I PSI will demonstrate the capability of the model for ballistic RV applications at low/moderate electron density levels. Extensions to a computer code that addresses maneuvering RV flowfields, as well as unlimited electron densities, would be carried out in Phase II.

POWER SPECTRA, INC.  
42660 CHRISTY STREET  
FREMONT, CA 94538  
Phone: (408) 522-9538

Topic#: 92-172 ID#: 92WL0-071  
Office: WL/MNPB  
Contract #: FO8630-92-C-0044  
PI: DR. CHARLES LEUNG

Title: High Current OHMIC Contacts for Gallium Arsenide

Abstract: The problem of preparing reliable, uniform low-resistance ohmic contact has posed considerable problems for the GaAs manufacturer, in particular for high current applications. Based on the new information acquired in the last three years at power spectra and elsewhere, we now know that to fabricate reliable and high current contacts to gallium arsenide, all relevant areas of technology in the formation of the active region for ohmic contact must be understood and controlled. This proposal outlines a development program to investigate the various aspects of technology that are involved in the applicable types of OHMIC contacts and deposition techniques suitable for military fuzing applications.

PRECISION COMBUSTION, INC.  
25 SCIENCE PARK, SUITE 550  
NEW HAVEN, CT 06511  
Phone: (203) 786-5215

Topic#: 92-140 ID#: 92WL6-094  
Office: WL/POMX  
Contract #: F33615-92-C-2243  
PI: DR WILLIAM C. PFEFFERLE

Title: Catalytic Integral Ignitor/Injector for Improved Ignition/Stability and Altitude Relight

Abstract: Integrating a catalytic ignitor into an air blast fuel injector offers an opportunity to significantly improve flame stability and altitude relight, among other advantages. Previous work by precision combustion developing a catalytic glow plug has shown that a catalytic ignitor offers substantially improved ignition over conventional (non-catalytic) surface ignition devices. In this project we propose to use this improved ignition capability to achieve an effective integral high shear air blast ignitor/injector suitable for improving aircraft gas turbine ignition and blowout limits. In Phase I, a modified design of an airblast injector fitted with a catalytic ignitor will be made and bench tested. Testing in a laboratory annular segment combustor will explore ignition and blowout performance. These results will be used to optimize the catalytic ignitor/injector integration

## AIR FORCE SBIR PHASE I AWARDS

scheme for engine testing. Results will indicate potential for improvement based on this technology. A study of total system requirements and an optimized design concept will be conducted. Phase II will build on Phase I results to develop and test the technology for a gas turbine engine currently used or planned for use by the Air Force.

### PRO-TECH

3708 MT. DIABLO BOULEVARD, SUITE 215  
LAFAYETTE, CA 94549  
Phone: (510) 284-9690

Topic#: 92-061 ID#: 92PL2-051  
Office: PL/XPPP  
Contract #: F29601-92-C-0027  
PI: DAVID V. GIRI, PH.D.

Title: Approach/Design of High Gain Broadband Antennas: Fast-Risetime Applications

Abstract: The radiation of a narrow beam of electromagnetic fields over a broad spectrum of frequencies contained in a fast pulse is an important problem in antenna theory. Impulse radiating antennas (IRAS) are of interest in this solicitation. We propose to study a radiating tem horn and a reflector antenna fed by a tem horn, to broadcast the fast-risetime pulse. One begins with an aperture formulation of the antenna radiation, by specifying the tangential electric field on the aperture. This aperture field prescription will be determined in both cases by detailed calculations. For an aperture illumination that is like a step function, the resulting far field is impulse-like. The width of the impulse becomes very narrow as one approaches the prescribed direction of focus. Practical considerations of feed, impedance, breakdown strengths will be considered in our design study of these two candidate antennas.

PROMETHEUS, INC.  
21 ARNOLD AVENUE  
NEWPORT, RI 02840  
Phone: (401) 849-5389

Topic#: 92-035 ID#: 92ES2-111  
Office: ESD  
Contract #: F19628-92-C-0140  
PI: JAMES S. BYRNES

Title: Command, Control, Communications, Countermeasures Measure of Effectiveness Concept and Decision Making Tool

Abstract: The prioritization of threats and the prioritization of targets represent a crucial aspect of current Air Force planning. In a world where the potential threats are increasing while the available resources are decreasing, a model is required which will enable the quantitative comparison of all levels of possible tactical and strategic decisions. We will begin the development of such a model during Phase I and complete it in Phase II.

PSI TECHNOLOGY COMPANY  
20 NEW ENGLAND BUSINESS CENTER  
ANDOVER, MA 01810  
Phone: (508) 689-0003

Topic#: 92-177 ID#: 92WL9-014  
Office: ASD/NAF  
Contract #: F33657-92C-2096  
PI: MICHAEL B. FRISH

Title: A Thermal Imaging System for NASP Structural Testing

Abstract: PSI Technology Company (PSIT) proposes to build and demonstrate an optical instrument for reliably and accurately measuring the temperatures of advanced structural materials being tested for use in hypersonic aerospace vehicles such as the National Aerospace Plane (NASP). The instrument will be an adaptation of PSIT's innovative short-wavelength optical pyrometry concept, but will be designed to avoid interferences due to reflection or scattering of the emission from the vortex lamp used to heat the materials. A capability for single point measurements over the entire temperature range of interest and with the desired temperature accuracy and resolution will be demonstrated at the NASP High Temperature Testing Laboratory during Phase I. This will demonstrate the feasibility of developing and delivering a thermal imaging instrument with the same accuracy during Phase II.

Q-DOT, INC.  
1069 ELKTON DRIVE  
COLORADO SPRINGS, CO 80907  
Phone: (719) 590-1112

Topic#: 92-048 ID#: 92ES3-099  
Office: RL  
Contract #: F19628-92-C-0144  
PI: DONALD L. HERMAN, JR.

Title: HBT Delta-Sigma Analog-To-Digital Converter

Abstract: There are numerous applications for a high-resolution (16-bit) and in military and commercial communications, phased-array radar and electronic warfare systems. Q-dot proposes a high-resolution (16- to 18-bit) 100 ms/s BHT delta-sigma

## AIR FORCE SBIR PHASE I AWARDS

a/d converter. A multibit architecture reduces the oversampling ratio from 1000:1 to 50:1 (for 16 bits) minimizing the technical risk. The reduced clock rate and the monolithic approach lowers the a/d power requirements. The delta-sigma architecture provides insensitivity to process variations# improving device yield. On-chip demultiplexing may be used to provide initial decimation as well, reducing the data rate from the delta-sigma modulators into the digital filters. These features enhance the design's usefulness for antenna arrays where large numbers of a/d's may be required. A unique input buffer also serves as the modulator filter and difference amplifier. An innovative a/d-d/a design will create a very-high-speed building block useful for subranging a/d's as well as the proposed delta-sigma a/d. This building-block also has applications in RF front ends# providing rapid gain-control feedback for abc or signal demodulation/detection. During Phase I, preliminary cell designs will be evaluated and the a/d's performance estimated. A state-of-the-art inp met process will be used to produce prototypes during Phase II.

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Topic#: 92-059 ID#: 92PL2-036  
Office: PL/XPPP  
Contract #: F29601-92-C-0033  
PI: THOMAS E. LINNENBRINK

Title: A Low-Power, High-Speed, Multiple-Channel Transient Recorder

Abstract: Q-Dot proposes to develop a low-cost, high-performance transient recorder for use in high-energy physics experiments. Heretofore, the recording of complete, amplitude vs. time histories from detectors has been desirable but prohibitively expensive and limited in versatility. Single-channel per chip, 1 gs/s transient recorders using charge-coupled devices (CCDS) have demonstrated the capability of recording 1 GHz bandwidth data at higher rates. Since the cost of single-channel recorders is dominated by control and support circuitry, a two-prong strategy is proposed to lower cost: 1) build multiple recording channels on each chip; and 2) minimize control and support functions. Four, 4 gs/s transient recorders, each with 4 Us records, are proposed per chip. (The same chip will operate as 16, 1 gs/s recorders, also with 4 us records.) Control and synchronization functions available through the vxi bus (ref. 1) will be exploited to minimize support. Each D-size module will provide 16, 4 gs/s channels at a nominal cost per module of \$8,000 to \$16,000, or \$500 to \$1,000 per channel. Cost may be further reduced if common control functions can be maximized. Phase I will result in a detailed recorder design and the demonstration of 1 GHz bandwidth hardware. The multichannel recorder will be developed in Phase II.

QUADRANT ENGINEERING, INC.  
55 CHERRY LANE  
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Phone: (413) 549-0568

Topic#: 92-082 ID#: 92PL4-031  
Office: PL/OLAA  
Contract #: F19628-92C-0075  
PI: MARK GOODBERLET

Title: Passive Microwave Imaging Through Smoke and Obscurants

Abstract: We request funds to support research aimed at improving techniques to penetrate smoke and the atmosphere using and advanced passive microwave/millimeter wave concept developed by the University of Massachusetts. This technique, referred to as aperture synthesis or synthetic aperture radiometry, is a new earth remote means to develop spatial resolutions and wide swath with thinned array antennas. The intent of this study is to increase the operating frequency beyond the L-band frequency used by the university of massachusetts and to increase the capability of the systems; i.e., finer resolution and more beams. The Phase I study will develop proof of concept of a few candidate systems. Preliminary design will be done to actually fabricate a prototype system for independent test by the Air Force.

QUANTIC INDUSTRIES, INC.  
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SAN CARLOS, CA 94070  
Phone: (415) 637-3036

Topic#: 92-171 ID#: 92WLO-020  
Office: WL/MNPB  
Contract #: FO8630-92-C-0041  
PI: ROBERT R. DURRELL

Title: Advanced Missile Safe and Arm (S&A) Concepts

Abstract: Quantic industries, Inc., has been a major force in the transition of safe and arm (S&A) devices from all-mechanical out-of-line to all-electronic in-line. However, in some cases, a hybrid mix of electronics and mechanisms would result in more effective (S&A) in terms of life cycle cost and/or size/weight while still meeting the required performance and safety/reliability requirements. In order to select the best possible solution for an advanced missile S&A, the available technologies must be evaluated against the desired attributes using the system specific constraints. Such a comprehensive trade study requires several



## AIR FORCE SBIR PHASE I AWARDS

man-months of effort as proposed herein. The trade study requires identification of both system and programmatic constraints, postulating generic designs which mix and match all available technologies which could meet those constraints, and evaluating the common attributes of each design against each other and/or a specified baseline design to select the best candidate(s) design. The proposal provides an example of the evaluation matrix which will be used and one sample postulated design.

### QUANTITATIVE TECHNOLOGY CORP.

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Topic#: 92-117  
Office: WL/FIOP  
Contract #: F33615-92C-3004  
PI: LENARD CLAPP PH.D

ID#: 92WL4-055

Title: Three-Dimensional Mapping of Hypersonic Flow Fields Using Electron-Beam Fluorescence

Abstract: Advanced experimental methods that can provide quantitative flow field imaging data in hypersonic flows are required for the development of advanced hypersonic technology and the validation of computational fluid dynamic codes. To satisfy these requirements, an evaluation of potential improvements in the electron-beam fluorescence technique used for planar flow visualization in the 20-inch hypersonic wind tunnel at Wright Laboratories will be conducted. Methodologies for improvement in the measurement of the density and rotational and vibrational temperature of the molecular nitrogen will be evaluated in the context of the existing electron-beam source, image system, and wind tunnel operating characteristics. Essential features of the electron-beam fluorescence technique to be used in the evaluation include: beam propagation characteristics, spatial resolution, simulation of fluorescence spectra and signal level, and minimum measurement time requirements to maintain an acceptable signal-to-noise ratio. Recommendations will be provided on the design characteristics of an appropriate electron-beam fluorescence imaging system and associated image processing schemes to obtain quantitative flow field measurements of gas density and temperature in a hypersonic flow.

### QUANTUM EPITAXIAL DESIGNS, INC.

115 RESEARCH DRIVE  
BETHLEHEM, PA 18015  
Phone: (215) 861-6930

Topic#: 92-038  
Office: RL  
Contract #: F19628-92-C-0151  
PI: LARRY W. KAPITAN

ID#: 92ES3-012

Title: Optimization of InGaAs/InAlAs/InP EOIC Structures: An MBE Material Parameter Study

Abstract: Phase I of this program will optimize the growth of lattice matched InGaAs/InAlAs on InP for EOIC applications through the use of innovative molecular beam epitaxial (MBE) growth and calibration procedures. The program will study the effects of slight lattice mismatch on thick epitaxial layers. The program will develop a more accurate means of setting the molecular beam ratios as well as novel, easy-to-use characterization for post growth analysis of lattice matched EOIC structures. The program will also supply 3" EOIC wafers to DOD facilities for device processing and testing.

### QUEST INTEGRATED, INC.

21414-68TH AVE SOUTH  
KENT, WA 98032  
Phone: (206) 872-9600

Topic#: 92-116  
Office: WL/FIOP  
Contract #: F33615-92C-3208  
PI: GARY B. WHITE

ID#: 92WL4-051

Title: A Damage-Assessment and Temperature-Measurement System Suitable for Thermo-structural Testing of Composite Materials

Abstract: Advanced aerospace programs require materials capable of operating in temperature environments exceeding 2000°F. To assess the thermal and structural performance of these materials, testing must be performed at high temperatures. New techniques are needed to monitor and assess material performance under these test conditions. Proposed is the development of an imaging system for monitoring thermo-structural testing of composite materials at temperatures exceeding 2000°F. This development program will combine and extend recent advances in the fields of thermal-wave infrared imaging and damage assessment via computer-based artificial-intelligence (AI) systems. As part of this program, an experiment will be conducted to demonstrate the feasibility of developing a real-time IR imaging system to acquire, archive, and interpret thermal images of composite material specimens during mechanical and thermal testing. Images will be analyzed by an appropriate failure model and to describe, in a quantitative manner, how damage develops and propagates within the material. In addition, a temperature-measurement technique will be developed to provide a reliable means of accurately measuring specimen temperature.

## AIR FORCE SBIR PHASE I AWARDS

RADEX, INC.  
3 PRESTON COURT  
BEDFORD, MA 01730  
Phone: (617) 275-6767

Topic#: 92-089 ID#: 92PL5-004  
Office: PL/OLAH  
Contract #: F04701-92-c-0045  
PI: DR. MICHAEL J. KENDRA

Title: Computer-Efficient Models of Thermospheric Density and Composition

Abstract: The problem of developing computer-efficient thermospheric density models is addressed, and design investigations for improving the accuracy and speed of satellite orbital predictions in low earth orbit are proposed. Early computer models of the atmosphere were derived using quasi-static diffusion models, based primarily on satellite orbital decay data. Recent models include data from composition measurements, and more elaborate first-principles codes such as TIGCM, however without satisfactory improvement in decay prediction capability. The latest models provide thermospheric winds, a first order effect on satellite drag which has generally been ignored in orbit propagation software. Extensive and correlated satellite orbital histories are available, and may be used to evaluate these models for accuracy and design. Both research and software engineering development approaches are proposed in order to establish benchmarks, improve code efficiency, develop diagnostic tools, and identify deficiencies thru testing and thru theoretical considerations. This is proposed in Phase I.

RISON RESEARCH CORP.  
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TUSCON, AZ 85711  
Phone: (602) 745-0400

Topic#: 92-019 ID#: 92AFO-020  
Office: AFOSR  
Contract #: FQ8671-9201222  
PI: MIKE PARKER

Title: Atomic Fountain Clock Using Laser Trapped and Cooled Cs Atoms

Abstract: The object of this work is to continue a program to build an atomic beam clock using laser trapped and cooled Cs atoms. It is hoped that this clock will be at least two orders of magnitude more accurate than conventional Cs clocks. At present an internally funded research and development program is underway to construct a laser cooled atomic trap for Cs atoms. In the proposed research, as these Cs atoms pass through a waveguide, they will be used to detect a 9.2 GHz clock signal. The number of atoms undergoing the clock transition will be measured and the results used to control a quartz oscillator. Experiments will be performed to determine the optimum value of various parameters. This will result in data for the design of an improved clock in phase 2. A new commercial atomic clock two to three orders of magnitude better than present clocks would result in improvements in navigation, astronomy, physics, geophysical research, etc.

SACH SINHA AND ASSOC., INC.  
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SAN FERNANDO, CA 91340  
Phone: (818) 365-9390

Topic#: 92-171 ID#: 92WLO-134  
Office: WL/MNPB  
Contract #: FO8630-92-C-0053  
PI: SACH SINHA

Title: Advanced Missile Out-Of-Line Safe and Arm Concepts

Abstract: The objective of this program is to evaluate how modern technology can be incorporated into the out-of-line safing devices. Specific advantages of an out-of-line fuze, especially the fact that it is a low voltage system, will be highlighted. Three out-of-line safing and arming design concepts will be developed. Programmable electronics for producing the arming signal, DC motors, and solenoids for the prime mover of the mechanical barrier, will be investigated. New detonator concepts such as laser diode detonators and a semiconductor bridgewire (SCE) detonator will also be studied. Recommendations of how the new safing and arming concepts can be integrated with the guidance system of the missile will be made.

SCIENTIFIC & ENGINEERING  
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AUSTIN, TX 78746  
Phone: (512) 328-5544

Topic#: 92-050 ID#: 92ES3-135  
Office: RL  
Contract #: F30602-92-C-0117  
PI: DOUG NEUSE

Title: Design Approach for High Performance Computing

Abstract: The goals of this project are a design and an implementation plan for a parallel programming environment (PPE) that integrates development of new parallel programs, conversion of sequential programs to parallel structure, functional validation and performance analysis. The PPE will integrate a directed graph model of parallel computation, including visualization and algorithm animation, with an object-oriented formulation of executable components, the parallel structure of the computation

## AIR FORCE SBIR PHASE I AWARDS

will be captured as hierarchically structured directed graphs in a visual representation that combines control and data now and can be translated to multiple or heterogeneous parallel execution environments. Most of the technological base for this PPE already exists among the code series of parallel programming environments developed at the University of Texas at Austin, the sesiworkbench modeling system and the E/S interactive support. System for conversion of Fortran programs to parallel structure developed and marketed by SES. These systems have hierarchical directed models as a common conceptual foundation and have had their effectiveness in their domains well-established. Thee challenge and the goal of this project is to integrate these capabilities with the object model of software components into a unified implementation that retains and adds to their individual capabilities.

SCIENTIFIC STUDIES CORP.  
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Topic#: 92-031 ID#: 92ES3-193  
Office: RL  
Contract #: F30602-92-C-0099  
PI: JAIME R. ROMAN

Title: Multichannel System Identification and Detection Using Output Data Techniques

Abstract: The problem of multichannel system identification and detection of desired signal information in the channel will be addressed based on techniques that utilize channel output data directly, without the requirement to estimate channel output correlation matrices. A model-based approach is proposed for multichannel system identification and detection, where the parameters of a state-space model are identified, and the model innovations sequence is used for detection in a likelihood ration formulation. Recent state-space system identification results will be extended and applied to the very broad and includes other well known model types (such as auto-regressive and auto-regressive moving average models). As such, it offers potential for a better model fit in the cases where other models are inadequate or approximate. The detection aspect of the techniques in the context of radar surveillance.

SECURE COMPUTING TECHNOLOGY CORP.  
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ARDEN HILLS, MN 55112  
Phone: (612) 482-7441

Topic#: 92-031 ID#: 92ES3-192  
Office: RL  
Contract #: F30602-92-C-0104  
PI: BARRY L. MIRACLE

Title: A Semi-Automated Downgrader for MLS Network Guards

Abstract: To be successful the C3I community has a need for secure, efficient computer systems that support their mission. An important element of current systems is the network guard. Several guards currently deployed allow transfers of information from low security levels to high security levels, but no general purpose guards are available that allow transfers from high to low. SCTC proposes to develop a semi-automated downgrade tool with a turntable heman review facility for the general purpose lockguard, and for other guard products. The semi-automated downgrade tool would provide a highly trusted and assured process for releasing information from system high computers to system low computers. Phase I of this effort include a study of requirements, architectures and security policy for the automated downgrader. Phase II of this effort will be the development of a prototype downgrader implemented on the lockguard.

SENSORS UNLIMITED, INC.  
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PRINCETON, NJ 08540  
Phone: (609) 466-4661

Topic#: 92-056 ID#: 92PL2-015  
Office: PL/XPPP  
Contract #: F29601-92-C-0034  
PI: DR GREGORY H. OLSEN

Title: Advanced Diode Laser Structures For 2-5 Um at 300K

Abstract: We propose to study the benefits and drawbacks of various advanced laser diode structures for the 2-5 um mid-infrared spectrum and to actually construct a working grating surface emitting (GSE) laser structure for 1.65 um during our Phase I period. This ambitious program takes advantage of technology already developed at the sri david Sarnoff Research Center for shorter wavelength devices. Dr. Ramon Martinelli of SRI will consult. Other structures under study include a) on-chip unstable resonators, b) non-regenerative diodes in external cavities, c) laser-amplifier photonic integrated circuits, d) antiguided, leaky arrays, and e) multi-quantum well structures. The wavelengths/power/temperature dependence, optical field patterns and ease of fabrication will be considered in our study. We will recommend the fabrication of one or more of these structures in Phase II and optimize the performance of the most promising structure out to 5 um.

## AIR FORCE SBIR PHASE I AWARDS

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ARLINGTON, VA 22209  
Phone: (714) 361-5660

Topic#: 92-002  
Office: AEDC  
Contract #:  
PI: SCOTT B. EVANS

ID#: 92AED-021

Title: Cryogenic Infrared Source Array

Abstract: In order to adequately test and simulate images from long wave infrared (LWIR) sensors, complex dynamic target and background scenes must be generated. Methods for generating such scenes in infrared (IR) are costly, time consuming, and inadequate. To reduce these drawbacks, IR scene generating arrays have been developed for in-the-loop simulation and testing of IR systems. Typically the IR scene generating arrays consist of an array of resistors that are heated to specific temperatures by joule heating. Several companies have developed arrays to operate as low as liquid nitrogen temperature (77k); however, to reproduce low background scenes, the IR source arrays must operate at much lower temperatures--to 20k. This puts an additional burden on the array since the circuitry must operate cold. Proposed is a method to solve the problems associated with a monolithic IR array. The concept uses electron beams generated by an array of vacuum microelectronics devices (VMDS) to heat the IR sources. This allows the silicon circuitry to operate at higher temperature because the IR source and the VMD drive circuitry are not physically connected. Also, nearly 100% fill factor can be achieved. This method has potential to produce very high speed and high resolution arrays.

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BEVERLY HILLS, CA 90211  
Phone: (213) 653-4717

Topic#: 92-051  
Office: RL  
Contract #: F30602-92-C-0101  
PI: KAM SING TSO, PH.D.

ID#: 92ES3-151

Title: Development of Reusable Ada Software Fault Tolerant Components

Abstract: This research will develop a library of reusable software fault tolerant (SOFT) components encompassing recovery blocks, n-version programming, and other fault tolerant techniques that do not require complete logical redundancy. The library will be developed using an object-oriented approach. The components will incorporate provisions for fault injection testing to allow for reliability assessment on the unit subsystem and system levels. To render reuse more effective, a domain-specific repository management system using the reliability library framework (ELF) developed under the STARS program will be created. A demonstration system implementing distributed recovery blocks on a network of workstations will be built using components from the library. The results of this demonstration will be used to assess how well the library and developed components address the needs of developers and overcome currently known problems of reusable software.

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Topic#: 92-067  
Office: PL/XPPP  
Contract #: F29601-92-C-0066  
PI: NICHOLAS J. TENKETGES

ID#: 92PL1-058

Title: Application of Hybrid Wafer-Scale Integration to Analog Electronics

Abstract: We propose to develop an innovative new form of hybrid wafer-scale integration (HWSI) to reduce the size, weight and noise levels in high-performance analog systems such as spaceborne infrared sensor preprocessors. In particular, we will employ special mesa structures to shield sensitive devices and interconnects and to isolate circuits from noise sources. We will also employ low-voltage logic in associated digital circuitry to reduce both noise generation and power consumption. These approaches will allow us to achieve an order of magnitude reduction in the size and weight of analog preprocessor systems over more conventional technologies. In Phase I we will carry out feasibility studies, component experimentation and preliminary designs. In Phase II we will fabricate and demonstrate a miniaturized, low-power analog system utilizing the new form of HWSI technology. We will be assisted on a subcontract basis for both phases by Aerojet's Electronic Systems Division. This firm is a leader in the development, manufacture and operation of spaceborne infrared sensor systems, including high-performance analog preprocessors.

SPACE INDUSTRIES, INC.  
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WEBSTER, TX 77598

Topic#: 92-011  
Office: AFCESA  
Contract #: F08635-92-C0062

ID#: 92CEL-118

## AIR FORCE SBIR PHASE I AWARDS

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Phone: (713) 338-2676

PI: DR DEZSO SOMOGYI

Title: Active Firefighter Cooling and Breathing System

Abstract: The objective of the Phase I effort is to define requirements, perform trade studies and develop concept designs for a fire fighter backpack that provides breathing and cooling, to meet the specific needs of the usaf. Several specific approaches, including ones based on proven cryogenic breathing suit cooling technology will be assessed against the USAF requirements developed in Phase I. Trade studies will be performed and the most promising concept will be developed to a preliminary design stage. Mathematical models will also be developed to predict system performance. Due to the extensive amount of prior development in cryogenic breathing and cooling technologies, space industries anticipates delivering a more detailed development of the system design and analysis than is implied in the Phase I topic description.

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Phone: (619) 455-1650

Topic#: 92-138

ID#: 92WL6-083

Office: WL/POMX

Contract #: F33615-92-C-2239

PI: DR DANIEL L. VRABLE

Title: Composite Generator Housing With Enhanced Thermal Management

Abstract: The proposed Phase I program will demonstrate a composite aircraft generator housing, or resonant convertor, which will be lighter, stronger, stiffer and have enhanced thermal management performance than the current aluminum component. In Phase I, Sparta engineers, working with a representative aircraft generator manufacturer (i.e., Leland Electrosystems, Inc) will develop an advanced composite generator resonant convertor conceptual design, evaluate material selections and establish a fabrication approach. Sparta will evaluate its innovative matched metal net molding process for fabrication of the composite resonant convertor. This process is ideally suited for cost-effective fabrication of small to medium size, complex, high performance, tight tolerance composite components. The feasibility of the selected design will be evaluated for selected operating conditions via detailed thermal and structural analyses. In addition, a small number of subscale demonstration articles will be fabricated. In the follow-on Phase II program, a full size composite generator resonant convertor will be fabricated and tested. This work will be directly applicable to current (F/A-18) and future (F-22) aircraft programs and will also support the more electric aircraft initiative.

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Topic#: 92-157

ID#: 92WLO-186

Office: WL/MNPB

Contract #: FO8630-92-C-0031

PI: MORENO WHITE

Title: Development of Advanced Materials for RAM Accelerator Projectiles

Abstract: The RAM accelerator is a ramjet-in-tube concept for accelerating projectiles to a very high velocities. It uses propulsive cycle similar to that of a conventional ramjet. The ram accelerator can operate in several regions: thermally choked subsonic, and two oblique detonation modes. The ignition of the fuel/oxidation moisture is achieved by forcing the mixture through a series of shockwaves that increase its temperature until the fuel reaches its ignition temperature. The typical RAM accelerator projectile is fabricated from magnesium with masses in the range of 45 to 70 grams. These projectile have obtained velocities up to 2500 m/s (4); however, velocities of up to 12 Km/sec. Are theoretically possible. One of the potential limiting factors of current ram accelerators is increased mass due to the use of monolithic metals. Advanced graphic/epoxy or metal matrix materials offer increased specific strengths of 3, to 5, that of magnesium. A significant projectile mass reduction would allow higher velocities at the current thrust levels which are achievable existing launch facilities. In this program, Sparta will investigate the feasibility and payoff of designing ram accelerator projectiles using advanced high specific strength composite materials. Sparta will also investigate the use of high performance thermal coatings; to reduce the nosetip and leading edge ablations seen in current flight test. The use of advanced materials and coatings offers the potential to greatly increase the efficiency currently achievable in ram accelerator firings.

SPAUCHUS ASSOC., INC.

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ATLANTA, GA 30318

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Topic#: 92-098

ID#: 92PL6-007

Office: BMO/MYSP

Contract #:

PI: DAVID R. HENDERSON

## AIR FORCE SBIR PHASE I AWARDS

**Title:** Replacement of Refrigerant R-12/R-22 Based Cooling Systems for Missile Guidance Systems

**Abstract:** The imminent phase-out of chlorofluorocarbon (CFC) refrigerants, in particular CFC-12, necessitates identification of a suitable alternative refrigerant which is atmospherically benign. For many new equipment applications, HFC-134a has emerged as the compound of choice due to thermodynamic properties similar to CFC-12, zero ozone depletion potential and low greenhouse warming potential. For existing CFC-12 equipment, the most desirable course of action is to identify a drop-in replacement refrigerant; such has not to date been found, and it is unlikely that such a refrigerant will be found. It is technically feasible, however, to remove the CFC-12 and accompanying lubricant, recharge with HFC-134a and a compatible lubricant, thus retrofitting the system without major equipment modification or replacement. A program to address the questions concerning compatibility, performance and reliability associated with such a retrofit is given in this proposal.

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**ONE PATRIOTS PARK**

**BEDFORD, MA 01730**

**Phone: (617) 275-6000**

**Topic#: 92-005**

**ID#: 92AED-041**

**Office: AEDC**

**Contract #:**

**PI: DR CHARLES C. BLATCHLEY**

**Title:** Real-Time Subsonic Flow Vector Probe

**Abstract:** Proposed research will incorporate five lithographically-generated microscopic hot-film anemometers into a single microscopic hot-dome probe. This will allow accurate, local measurement of all three components of airflow velocity. Feasibility of a macroscopic thin film resistor on such a probe has been demonstrated in a previous Phase I project, which also developed design criteria, including probe dimensions, power dissipation, and materials properties. The objective of the current proposal is to demonstrate that patterned filamentary resistors can be applied to a smooth, curved probe by lithography to shrink individual sensors, so that a complete five-sensor probe would be smaller than 1mm in diameter. The result will be a tiny, robust probe on an aerodynamic mount that will allow measurements to be obtained upstream of, or within, the inlet of full-scale aircraft engines. In addition, the accuracy of directional information, its speed of response, and the simplified analysis it permits will make this approach superior to other minimally perturbing or non-perturbing methods.

**SRS TECHNOLOGIES**

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**HUNTSVILLE, AL 35806**

**Phone: (205) 971-7020**

**Topic#: 92-080**

**ID#: 92PL3-069**

**Office: PL/OLAC**

**Contract #: F29601-92-C-0093**

**PI: PAUL A. GIEROW**

**Title:** Non-Imaging Secondary Concentrator

**Abstract:** The solar thermal rocket offers the optimum propulsion means for LEO to GEO transfer vehicles, provided that specific impulse (ISP) on the order of 1,000 seconds at moderate thrust levels can be achieved. These ISP's and thrust levels are contingent on the solar concentrator system providing high concentration ratios at the absorber. A concentrator system which uses two optical elements is a practical method of obtaining the desired concentration ratio. A secondary element of annular forward focusing geometry can increase the performance of the optical system. A secondary concentrator can also widen the acceptance tolerance band of the primary collector and vehicle pointing system. This redirects aberrant rays which without a secondary may have been lost or cause damage to the vehicle. The Phase I research will determine the optimum geometry for a secondary concentrator by performing geometric ray trace studies. A small experimental secondary will be constructed based on the results of the ray trace studies. A small experimental secondary will be constructed based on the results of the ray trace study. Laboratory laser ray tracing will also be done with a complete optical system to predict the total concentration ratio. The results of the Phase I will lead to a prototype design for construction and testing at the Phillips Solar Laboratory in Phase II.

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**Topic#: 92-153**

**ID#: 92XRX-079**

**Office: ASD/XRX**

**Contract #:**

**PI: WILFRED LEON GOODSON**

**Title:** Determine Technical Structure of An Air Force Conventional Warfare Analysis Center

**Abstract:** The extraordinary political changes since 1989 have led to abrupt and fundamental changes in the national military strategy of the United States, which in turn have totally altered the focus and substance of force planning toward regional conflict.

## AIR FORCE SBIR PHASE I AWARDS

In addition, the changed acquisition process greater, understanding of the dynamic interactions among force elements participating in regional conflicts (no non-material solution provisions of DODI 5000.2). The broad outline of the requirements of mission area planning organizational capabilities, tools, and systems is recognized, and most of the critical tools and systems have been developed at least to the degree necessary to have an initial capability to meet the specifications of the new acquisition directives. What remains is the institutionalization of a proper planning system within the Air Force. This demands a great deal of conceptual effort which is the object of this proposal. This research will examine the practical interface requirements between the necessary models and tools, along with the practical organizational responsibilities and relationships necessary to implement "strategy to task" comprehensively within the Air Force, using the concept of a "conventional warfare analysis center" as a starting point. The only existing commercially available theater level model which meets the requirements of "strategy to task" and DODI 5000.2, (OME-III/IV) will be used to evaluate and design practical interfaces to the existing lower level Air Force models.

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Topic#: 92-151 ID#: 92XRX-006  
Office: ASD/XRX  
Contract #:  
PI: JAMES R. ATCHISON

Title: Cost Methodology for Premilestone Planning I

Abstract: The objective of this project is to examine the feasibility of developing an IBM PC cost estimating model for determining the economic impact of incorporating emerging technologies into new weapon systems/subsystems during Premilestone I planning. The technology areas of interest to be examined are: advanced avionics, high-performance turbine engines and high-temperature materials. The effort to be accomplished during Phase I will include; developing a "functional requirements analysis" philosophy, designing an emerging technologies database, designing a data collection mechanism, defining a "regressive learning curve" theory and defining cost estimating concepts. The planned cost impacts concepts will encompass not only the direct costs but also the interoperational (i.e. industrial base, military and commercial infrastructures, logistics, training) costs associated with the incorporating new technologies into weapon systems.

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Topic#: 92-066 ID#: 92PL1-043  
Office: PL/XPPP  
Contract #: F29601-92-C-0069  
PI: LYN BOWMAN

Title: Microstructures for Heat Transfer In Stirlingmicro-Refrigerators

Abstract: Sunpower proposes to design microstructures for heat transfer in novel Stirling microrefrigerators inside multi-chip module packages for removing heat at low temperatures from wafer scale integrated circuits in space systems. The microrefrigerator exploits the material properties, mechanical designs, tiny dimensions, and batch fabrication processes of silicon micromachining. If feasible, the microrefrigerator will enable electronic devices bonded directly to the silicon cold plate, or fabricated within it, to be operated at temperatures from 250K down to 60K or less, depending upon the application-specific design. One preliminary 1cm<sup>3</sup> microrefrigerator design predicts 2.5W of heat lifting capacity from 225K to 350K with mechanical input power of 2.5W. The inertia of the vibrating actuator is only 10 to the -4g. For MXN greater heat loads, MXN microrefrigerators can be fabricated as a mechanically integrated mxn cm<sup>2</sup> array. The microstructures to be designed during Phase I include heat exchangers, micro-heatpipes, and micro-tubes for axial thermal conduction enhancement. Effects of the microstructures on the thermal performance of microrefrigerators will be determined, and a feasible heat transfer system selected for fabrication in Phase II.

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Topic#: 92-013 ID#: 92CEL-130  
Office: AFCEA  
Contract #: F08635-92-C0070  
PI: DR MARK DAUGHERTY

Title: Use of Superconducting Magnetic Energy Storage (SMES) to Improve Power Quality for Critical Air Force Applications

Abstract: Superconducting Magnetic Energy Storage (SMES) can help meet Air Force requirements for stored electrical energy in a very efficient and reliable manner. One application of SMES is to provide stored energy to ride through short term voltage

## AIR FORCE SBIR PHASE I AWARDS

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disturbances. Poor electric power quality is costing large U.S. electrical power consumers billions of dollars a year in downtime, product loss and equipment damage. We are proposing to introduce smes technology for electrical energy storage as a method to improve electrical power quality for critical Air Force operations. To the best of our knowledge, Superconductivity, Inc. (SI) is the only U.S. vendor with a completely designed, built and tested smes system. SI's Superconducting Storage Device (SSD (tm)) is a commercially available 1 mW SMES system that has been designed and built to provide carryover capability for large, critical industrial loads. Our existing system has high ac/dc conversion efficiencies and low power loss during dc storage. By modifying our commercial system we believe that we can provide a low cost and high quality method to improve the effectiveness and safety of critical Air Force applications.

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Topic#: 92-106 ID#: 92WL2-073  
Office: WL/AAOP  
Contract #: F33615-92-C-1062  
PI: ROGER J. FORSE

Title: An Active HTS Switch for Microwave Circuits

Abstract: The advantages of high temperature superconductors could be widely utilized in ew systems if a low loss, high-dynamic range switch, compatible with the cryogenic environment could be demonstrated. GaAs fet switches and pin diode switches are the main switch technologies used in microwave circuits, but neither type is optimum for use with HTS devices. STI has proposed an innovative three terminal device, based on the known anisotropy of high temperature superconductors, to achieve low loss switching. Phase I will be a feasibility study to determine the difference in critical current of an a-axis film in the c- and ab-axis directions. A simple switch will be fabricated to demonstrate the feasibility of this concept.

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Topic#: 92-112 ID#: 92WL3-025  
Office: WL/ELA  
Contract #: F33615-92-C-1068  
PI: Dr Peter P. Chow

Title: Carbon and Tellurium Doping Sources for Molecular Beam Epitaxy (MBE)

Abstract: We propose two novel sources for improved carbon and tellurium dopants in MBE growth for III-V compounds semiconductors where heavy doping is required. The compact carbon source is electron beam heated and has a very fast thermal response. It is expected that increased monatomic carbon species in the flux would improve the dopant behavior. The tellurium source produces ionized species which would increase the dopant incorporation significantly. Very high dopant levels could be achieved with the new sources. The new designs are compatible application to existing MBE systems is possible. The prototype desings will be tested in actual thin film growth to evaluate their effectiveness. The Phase I project is anticipated to lead to improved device performance by providing better dopant behavior. by providing better dopant behavior.

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Topic#: 92-135 ID#: 92WL5-088  
Office: WL/MLIP  
Contract #: F33615-92C-5937  
PI: DR. PETER P. CHOW

Title: Precise Flux Control for Lattice Matched Superlattice Materials

Abstract: An effective method for reducing flux transients in molecular beam epitaxy (MBE) effusion cell source is proposed. MBE is a useful technique for fabricating many important electronic and optoelectronic devices whose performance depends critically on reproducible material structures. Tight control of the structures is often hindered by flux transients during source shutter operation. We propose a method to eliminate these transients so stable flux can be achieved throughout the growth process. The technique incorporates features in the source cell-shutter assembly design that minimizes thermal transients and uses programmed temperature ramping to maintain stable flux. Elimination of flux transient will be demonstrated in actual MBE environment.



## AIR FORCE SBIR PHASE I AWARDS

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Topic#: 92-006 ID#: 92CEL-002  
Office: AFCESA  
Contract #: F08635-92-C0066  
PI: BRUCE ROBERTS

Title: Sandtank Testing of Surfactant Enhanced Remediation of Subsurface Contamination by Chlorinated Solvents

Abstract: Dense non-aqueous phase liquids (DNAPLs) are a class of organic compounds commonly found as ground water contaminants; chlorinated solvents are an important class of DNAPLs. Many DNAPLs are characterized as being immiscible with and heavier than water. These characteristics combine to make subsurface dnapl contamination particularly difficult to remediate. In general, DNAPLs released to the subsurface migrate downward leaving behind residual saturation concentrations in the unsaturated and saturated zones. If released in sufficient quantities, the DNAPL will form a free phase on impermeable materials at the base of the saturated zone. The residual saturation and free phase DNAPLs in the saturated zone represent a long term source of contamination for ground water because their aqueous solubility is much higher than their allowable drinking water standard. The key to remediation is removal of the residual and free dnapl from the subsurface. Surfactants in solution can emulsify or solubilize residual or free dnaps in the saturated zone if systems can be designed which will not experience significant losses due to adsorption or precipitation. The surfactant system must be selected based on the characteristics of the DNAPL, the aquifer solid media, the ground water, and the reservoir temperature if it is to be effective. The objectives of the proposed study are to assess the viability of using such surfactants or surfactant systems to remove free and residual saturations of dnaps from saturated soils by either mechanism, emulsification or solubilization, in a ten cubic foot test cell.

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Topic#: 92-031 ID#: 92ES2-028  
Office: ESD  
Contract #: F19628-92-C-0152  
PI: ARNOLD H. LANCKTON

Title: Integration of ADRI in JSIPS

Abstract: The arc digital raster image (ADRI) is a new mapping, charting, and geodesy product which has been developed by the Air Force. The ADRI is a digital orthophoto coupled with a file of digital terrain elevation data. The ADRI has been developed to rapidly derive the three-dimensional coordinates of any feature in the orthophoto. Currently the primary application of the ADRI is focused at the Air Force unit level but it has obvious applicability at both the force level and in the command, control and intelligence (C2I) areas, as well as several unique applications to the joint service image processing system (JSIPS). It is the intent of this investigation to explore and demonstrate the integration of the ADRI product in JSIPS to provide the following automated capabilities: (1) correlating ADRI with unexploited imagery to determine precise location of image corner coordinates, percent of and precise location of cloud coverage, determination of warping coefficients for image rectification, precise image registration for integration, and overlay of the ADRI image and other products; and (2) merging an ADRI with unexploited imagery can provide the image interpreter with an image reference for improving the speed and accuracy of reporting.

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Topic#: 92-100 ID#: 92WL2-011  
Office: WL/AAOP  
Contract #: F33615-92-C-1072  
PI: BARRY GRIFFITHS

Title: Performance Enhanced Navigation Using Neural Network Technology (PENANT)

Abstract: Synetics proposes a new method of fault detection and identification (FDI) for aircraft navigation systems, taking advantage of both neural network technology and advanced filtering technology. Neural networks offer a great deal of promise in the general area of fault detection, since their highly parallelized structure avoids most of the computational difficulties associated with a time-tagged fault tree. In particular, recent work indicates that the multi-layer perception architecture can give good fdi performance for some applications. In order to take advantage of neural nets for the aircraft FDI application, it is necessary to first compensate for the mission-dependent, time-varying, non-stationary nature of typical navigation error processes. Also, it is necessary to create neural net inputs over a long enough time horizon to successfully diagnose faults, while preserving the ability to eliminate the faulty information. Synetics proposes to accomplish this by pre-filtering the sensor data through a synthetic measurement generator, based on synetics net information approach (NIA) distributed Kalman filter algorithm. Phase I will include actual training and testing of a prototype hybrid neural net/smg for a reduced-order FDI

## AIR FORCE SBIR PHASE I AWARDS

problem.

SYSTEM PLANNING CORP.  
1500 WILSON BLVD.  
ARLINGTON, VA 22209  
Phone: (713) 333-2666

Topic#: 92-084 ID#: 92PL4-034  
Office: PL/OLAA  
Contract #:  
PI: R. JERRY JOST

Title: Spaceborne Relativistic Electron Accelerator System

Abstract: The ability to generate intense, enhanced ionization in the lower ionosphere has been demonstrated on several active space-based experiments using neutral- and charged-particle beams. These previous programs utilized relatively low energy and low power electron and hydrogen beams which limited both the depth of atmospheric penetration as well as the enhanced plasma density production. Technical advances within the x-ray radiography industry has enabled the commercial development of highly efficient electron linear accelerators for x-ray production. This project will harden a commercially available MEV electron linear accelerator for space flight applications. A flight qualified hollow cathode plasma contactor will also BIE included in the system design to ensure spacecraft electrical neutrality.

SYSTEMS EXPLORATION, INC.  
4241 JUTLAND DR  
SAN DIEGO, CA 92117  
Phone: (513) 256-5357

Topic#: 92-115 ID#: 92WL4-075  
Office: WL/FIOP  
Contract #: F33615-92-C-3209  
PI: GARTH R. COOKE

Title: Corrosion Detection and Life Analysis for Aircraft Structural Integrity

Abstract: This proposal responds to the USAF's stated need for research to develop a corrosion detection technique which can detect the onset of corrosion and to develop a fatigue life analysis capability which accounts for corrosion effects. The proposed methodology is to develop corrosion kinetic equations which can predict the onset and progress of corrosion with high confidence, develop an improved corrosion detection method which detects actual corrosion cells, develop a stochastic corrosion prediction model which uses the kinetics equations as state transition functions, and develop a methodology for marrying the corrosion prediction model with existing fatigue life analysis models.

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Topic#: 92-154 ID#: 92XRX-077  
Office: ASD/XRX  
Contract #:  
PI: ARTHUR E. SCHWANINGER

Title: Decision Support System for Early Acquisition Support

Abstract: The early acquisition support estimator (EASE) is an ibm pc-based decision support system for pre-milestone I acquisition decision making. It provides life cycle cost (LCC) information concerning the logistic design options that may be included in a weapon system design. The tool is designed to provide a user-friendly interface that will facilitate low data input time and also provide easy-to-interpret output. It has the capability to integrate the impacts of new emerging technologies on the LCC of a weapon system. Operational scenario options, performance factors, supportability options, deployment location, and maintenance system concepts will also be included in the logistics LCC computations.

TACAN CORP.  
2330 FARADAY AVENUE  
CARLSBAD, CA 92008  
Phone: (619) 438-1010

Topic#: 92-031 ID#: 92ES3-191  
Office: RL  
Contract #: F30602-92-C-0107  
PI: JAMES H. BECHTEL

Title: Large Dynamic Range, Linear Response Laser

Abstract: Fiber-optics technology for modern communications requires wide bandwidth, large dynamic range, performance analog data links. In order to improve these fiber-optic systems, progress is needed to reduce the demands on the optical transmitter. The development of large dynamic range, linear response optical transmitters would allow significantly lower cost lasers to be used in many analog data links for video, sensor, and microwave signal distribution and improve the effectiveness of high-performance DFB laser transmitters. Our approach will decrease the distortions caused by second and third order

## AIR FORCE SBIR PHASE I AWARDS

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harmonics of a signal and by cross modulation with other signals in the transmission path, will also suppress relative intensity noise from the laser transmitter. Because the linearity of laser output versus current input is a function of laser power for existing lasers, the power can only be increased by limited amount before the integrity of the analog link is reduced for increased power. Our technology uses an innovation in laser noise reduction and distortion suppression to improve the performance and extend the applications of fiber-optic data links.

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CARLSBAD, CA 92008  
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Topic#: 92-066 ID#: 92PL1-024  
Office: PL/XPPP  
Contract #: F29601-92-C-0103  
PI: STEPHEN R. SCHAEFER

Title: Thermal Management for High-Density Electronics Using Epitaxial Liftoff Technology

Abstract: We propose to use epitaxial liftoff technology to remove semiconductor layers which are only a few micrometers thick from the original substrate. The removed layers can then be transferred to a heat conducting material which is also a good electrical insulator. This type of structure maximizes the thermal conductivity between the device layers and substrate. This type of structure can also facilitate three-dimensional integration by allowing the device layers of semiconductor material, separated by electrically insulating layers to be stacked together. In Phase I we will demonstrate the ability to transfer layers of epitaxially grown material to a diamond substrate, where the heat transfer between the epitaxial film and the substrate will be tested. We will develop designs for active and passive heat dissipation from both two and three-dimensional structures. We will consider three different approaches to heat dissipation from the immediate vicinity of the device: 1) passive thermal spreading, 2) forced liquid cooling, and 3) integral heat-pipe cooling. We will choose one of the latter approaches, and will design a demonstration system to be fabricated in Phase II.

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Topic#: 92-142 ID#: 92WL6-039  
Office: WL/POMX  
Contract #: F33615-92-C-2242  
PI: RON GRAYSON

Title: Unique Optical High Temperature Sensors for Turbine Engines

Abstract: Accurate measurement of turbine engine temperatures under actual operating conditions remains a major technical challenge due to the harsh engine environment. Reliable high temperature data will result in improved engine designs and performance. Tacan will study two versions of a new optical sensor utilizing rare earth materials with high temperature light guides. One sensor will use thermographic phosphors adhered to the end of ceramic waveguides. This design concept eliminates the line-of-sight and attenuation problems present in the current technique of applying phosphors to engine surfaces and transmitting the excitation and signal beams across free space or through combustion gases. The second sensor version replaces the excitation light source and its optics train with a radioisotope located in the sensor head. Based on our experience with high temperature materials and fiber optic sensors, we expect to show the feasibility of our approach to obtain reproducible and accurate engine temperature data without perturbing flows or requiring component trenching. The sensors which result from our research will complement existing fiber optic temperature sensors and will find applications in unique environments. Our research will also lead to the development of self-luminous materials which can be used in paints and markings.

TAU CORP.  
485 ALBERTO WAY  
LOS GATOS, CA 95032  
Phone: (408) 395-9191

Topic#: 92-101 ID#: 92WL2-024  
Office: WL/AAOP  
Contract #: F33615-92-C-0173  
PI: PETER L. ROTHMAN

Title: Formal Mathematical Methods for Sensor Management

Abstract: In the past, sensor management systems have been constructed utilizing a variety of ad hoc methods and heuristic "rules of thumb." Little or no attempt was made to provide a consistent intellectual framework or system level architecture for supporting sensor management functions. This approach made it difficult to utilize system level requirements to define sensor management functions and performance requirements. In contrast, with a formal mathematical approach to sensor management, the conditions under which the sensor management system will meet specific numerical requirements can be determined analytically. This is extremely important in the analysis of alternative sensor management architectures and algorithms. The

## AIR FORCE SBIR PHASE I AWARDS

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proposed research will develop formal mathematical methods for sensor management. Both broad theoretical frameworks, and specific algorithmic approaches will be examined during the Phase I effort.

TDA RESEARCH, INC.  
12421 W. 49TH AVE, #6  
WHEAT RIDGE, CO 8033  
Phone: (303) 422-7953

Topic#: 92-147 ID#: 92WL6-096  
Office: WL/POMX  
Contract #: F33615-92-C-2247  
PI: MICHAEL E. KARPUK

Title: Supercritical Heat Exchangers for Hypersonic Aircraft

Abstract: The heat loads on board military aircraft have historically increased with higher maximum speeds and greater use of heat generating electronics. The heat load is dissipated by heating the fuel prior to its combustion. Today's aviation fuels, such as JP8, can be heated to 325 degree F (163oc) without significant degradation. This maximum temperature is constraining the design of future aircraft and their weapon systems. Advanced fuel chemistry may allow operation temperatures up to 900°F (483°C) which is above the critical point of most hydrocarbons. Consequently, conventional aircraft heat exchanger designs may not be acceptable at the high temperature, pressure and highly variable heat transfer properties of the supercritical fuel. TDA research proposes a systematic investigation of the design of supercritical heat exchangers suitable for hypersonic aircraft. This will lead to a hardware test in Phase II.

TECHNICAL RESEARCH ASSOC., INC.  
410 CHIPETA WAY, SUITE 222  
SALT LAKE CITY, UT 84108  
Phone: (801) 582-8080

Topic#: 92-020 ID#: 92AL -212  
Office: AL  
Contract #: F41624-92-C-9000  
PI: GAIL BOWERS-IRONS

Title: Biodegradation of AF Medical Wastepaper Products

Abstract: In the past decade, wastepaper recycling has gained a wider acceptance. Depletion of tree stocks, waste water treatment demands and environmental awareness have driven recycling both in government and industrial spheres. Using greater quantities of wastepaper stock reduces the need for virgin fiber and minimizes the problem of solid waste disposal. Prior to recycle, hot water and chemicals separate and disperse the fibers. Those materials which are removed with the hot water and chemical treatment include: 1) dyes; 2) size; 3) phenol-formaldehyde and urea-formaldehyde; 4) amine-resins; 5) wax, and naphthalene-indene resins and polyethylene and 6) adhesive binders. In preliminary work, technical research associates, incorporated (TRA) has performed groundwater studies to test the biodegradation of Air Force sanitary wastepaper resins and binders which must be removed before recycle processing. This project will identify the preferred operating and support conditions; determine the rate and extent of biodegradability; determine the composition and amount of waste products and design and deliver a prototype process design.

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Topic#: 92-023 ID#: 92AL -114  
Office: AL  
Contract #: F41624-92-C-6005  
PI: OWEN D. BRIMMHALL

Title: New Actuators for Human Sensory Feedback

Abstract: The overall objective of this project is to integrate terfenol-d into new actuator designs applicable to dexterous exoskeletal feedback systems for telerobotic applications. The development of new efficient, responsive, small, lightweight actuators is critical to the achievement of sensory feedback systems for intuitive, real time human operation of telerobotic systems in hazardous or otherwise restrictive environments. This Phase I project will explore the feasibility and capability of these magnetostrictive actuator mechanisms to provide realistic force and position feedback for robotic end-effectors. The project will establish and study new terfenol-d actuator designs adapted specifically for these feedback systems and will demonstrate, test and evaluate the effectiveness of both resistive variable brake devices and higher order active linear motor actuator prototypes. The actuators will be modular by design and when refined in Phase II will allow transfer and application to varied mechanical feedback systems including adaptive structures and other electromechanical systems of utility to military, space and private sector systems.

## AIR FORCE SBIR PHASE I AWARDS

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Topic#: 92-028 ID#: 92AL-197  
Office: AL  
Contract #: F41624-92-C-9001  
PI: GAIL BOWERS-IRONS

Title: Biodegradation & Bioaccumulation of Metals From Surface Treatment Wastes

Abstract: Chemically removed spent aircraft metals and their salts whose wastes are of great concern to the Air Force can include chromium, cobalt, nickel, aluminum, titanium and magnesium. Environmental laws concerning the disposal of these waste materials are becoming increasingly strict and new processes must be developed which are efficient and cost-effective while complying with epa regulations. At present, most of these waste materials are land-filled or incinerated. Incineration is often considered the best disposal option, with the lowest long term risks. But incineration does not ameliorate the now recognized hazards to human health and the environment. Researchers at Technical Research Associates, Incorporated (TRA), believe that an innovative biological process which does minimize the waste problem could be developed. The operation would be two-fold; nonsoluble, chemically removed, spent aircraft metal salts would be dissolved with a patented TRA-modified archaebacteria isolate. These solutions as well as soluble salt mixtures would then be accumulated via a TRA-hybridized lemnna minor isolate. TRA believes that this coupled process, based on prior work, is a viable system which would mitigate the hazardous waste problem, in a cost effective and efficient manner.

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Topic#: 92-132 ID#: 92WL5-195  
Office: WL/MLIP  
Contract #: F33615-92C-5943  
PI: GAIL BOWERS-IRONS

Title: The Biodegradation of Spent Pre-Preg Materials

Abstract: Thermoset resin impregnated yarns, fabrics and tapes (prepregs) comprise a significant fraction of the materials used in the fabrication of current and developing Air Force aircraft systems. Two problems exist, however, with the prepreg materials. These materials have only a six-month shelf life and there can be residual or non-spec waste materials generated. The spent prepreg wastes, now reported to be environmentally unsafe, may include uncured resin and rejects at all steps of the fabrication process. Current disposal methods such as incineration, autoclaving or landfilling will soon lack epa acceptance due to the production of poisonous decomposition products. In response to this toxic waste problem, Technical Research Associates (TRA) proposes to develop a regulated and contained biodegradation process which would eliminate the reported environmental and health hazards caused by present disposal systems. Preliminary work has shown that TRA's biodegrading bacteria and/or fungi have the potential to degrade the spent prepreg thermoset resins. This would allow the separated fibers to be recycled or safely landfilled.

TECHNOLOGY ASSESSMENT & TRANSFER, INC.  
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ANNAPOLIS, MD 21401  
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Topic#: 92-135 ID#: 92WL5-241  
Office: WL/MLIP  
Contract #: F33615-92C-5942  
PI: DR. YUE CONG

Title: Real Time, Self-Directed MBE Flux Control Incorporating In Situ Ellipsometry

Abstract: Many of the performance driven demands of future Air Force weapon systems are dependent on the availability of advanced semiconductor, bandgap engineered devices and components. Molecular beam epitaxy (MBE) is the preferred method for creating these. But in order to reach the required goal of high purity, monolayers with atomically abrupt heterojunctions, process control of all deposition parameters is critical. The most important of these is beam flux. Control over the flux will be achieved by completing the development of a self-directed, auto-learning system that incorporates real time, in situ ellipsometry. During Phase I of this effort, the feedback temperature and shutter control system will be completed, and ellipsometry will be interfaced with an mbe machine in order to achieve in situ monitoring of the deposition process. A Phase II work plan will be completed describing in detail how the results of this Phase I effort will be integrated into the control system. A plan for transferring the control technology to industry will be completed by introducing mbe systems and ellipsometer manufacturers to the capability being developed. This will include a demonstration of the control capability at the end of Phase I.

## AIR FORCE SBIR PHASE I AWARDS

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Phone: (504) 652-1127

Topic#: 92-013 ID#: 92CEL-135  
Office: AFCESA  
Contract #: F08635-92-C0072  
PI: DR M.A. HILAL

Title: A Prototype of A Superconductive Magnetic Energy Storage (SMES) System for Air Force Use

Abstract: TII will develop the skeletal structure for a proof-of-concept (POC) design of a 1 mW superconductive magnetic energy storage (SMES) system and will provide a concept of operation to include details on suggested design, component specifications, and estimated cost and payback. The SMES system will be designed to meet Air Force power storage requirements with an overall efficiency approaching 94 percent. The requirements include, high ac/dc conversion efficiencies, low/minimal power loss during dc storage, low cost, and low density/Kw. The design and manufacturing of such a system will increase the use of stored electricity in the Air Force, which is minimal in today's Air Force. Future Air Force 21 concepts envision highly mobile, rapidly deployable combat forces quickly responding to dynamic battle field situations.

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WISCASSET, ME 04578  
Phone: (207) 882-7589

Topic#: 92-020 ID#: 92AL -148  
Office: AL  
Contract #: F41624-92-C-5005  
PI: CHARLES J. BENTON

Title: Concept Development and Design of A Semi-Automated Flight Evaluation System (SAFES)

Abstract: Design and development of a semi-automated flight evaluation system (SAFES) is proposed. This will involve the integration of custom software, a microcomputer, software utilized by the USAF in learning abilities measurement, and precision aircraft instrumentation. SAFES will improve flight training programs by providing specific, objective records of pilot flight data acquired in the performance of specific maneuvers. SAFES can be used to provide data reflecting the effectiveness of new instrumentation systems, control systems, or any other design where skill acquisition or human factors play major roles. Additionally, SAFES data can provide a historical record of pilot skills for research purposes, allowing examination and correlation of objective data to be made throughout the pilot's career. Phase I will include refinement of the conceptual design, preliminary design specification, functional analysis, trade-off and optimization study, and development of a final design specification to be used in Phase II. The overall objective is to design a feasible, low-cost flight performance measurement and evaluation system that can be constructed, verified, and refined in Phase II. The development of safes technology will exploit recent developments in performance measurement (bfits flight criteria methodology) and new hardware capabilities (low cost high performance microcomputers and flight instrumentation systems).

TERA RESEARCH, INC.  
1344 BORDEAUX DRIVE  
SUNNYVALE, CA 94089  
Phone: (408) 734-3096

Topic#: 92-034 ID#: 92ES2-094  
Office: ESD  
Contract #: F19628-92-C-0147  
PI: DWAYNE R. MANN

Title: Remote Detection of Mobile Missile Launchers

Abstract: Tera Research will investigate the use of fractal signal processing to detect mobile missile launchers in remotely sensed imagery. This new approach based on self-similar stochastic models provides direct data fusion of multispectral and SAR imagery. Inherent parallelisms in the algorithm allows real time implementations with parallel processor architectures. With this approach, missile targets are represented by a fractal time series model corresponding to a L/F stochastic process. The digital images are modeled as a sum of fractal processes corresponding to the superposition of target, background and noise. Parameters of the model including fractal dimension will be used to detect and identify targets of interest. This approach differs from previous fractal approaches in at least two ways. First, the fractal estimator is optimal in the sense that it is based on the wavelet transform, which is a candidate whitening filter for the L/F process. This approach therefore accounts for the effect of noise on the estimation process. Second, the entire fractal process is estimated, rather than just a single parameter, such as the fractal dimension. Therefore, the representation is much richer and will perform more effectively in the presence of noise.

THE NAVTROL COMPANY, INC.  
9204 MARKVILLE DR  
DALLAS, TX 75243

Topic#: 92-119 ID#: 92WL4-070  
Office: WL/FIOP  
Contract #: F33615-92C-3608

## AIR FORCE SBIR PHASE I AWARDS

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Phone: (214) 234-3319

PI: DR RICHARD J. BROWN

Title: Common Input/Output (I/O) Interfaces (CIOI) for Vehicle Management Systems

Abstract: The principal technical objective of this proposed SBIR Phase I study will be to examine flight control sensor and actuator interface requirements and determine applicability of dsp technologies towards creating common I/O modules to replace the various interfaces. A small, light weight, high capability, adaptable common inputs/output interface (CIOI) will be conceptually designed, its feasibility established and its implementation planned. By appropriate programming and possible other adjustments, this CIOI is to replace the various interfaces presently associated with aircraft flight control and vehicle management systems. The principal CIOI module is an intelligent measurement and control device which achieves adaptability to various interface requirements by use of programmable analog/digital interface circuits, programmable digital arrays and a programmable digital signal processor (DSP). The expected size of the compact CIOI board is only 3"x3.75"x1", including power supplies. A Phase I final report will define in detail results of the study.

THE REJEN COMPANY

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BISHOP, CA 93514

Phone: (619) 387-2312

Title: Fuel Dump Impact Assessment Model

Abstract: The objective of this program is the development of a prototype, microcomputer based model that will compute the quantities, locations, and distributions of fuel jettisoned by aircraft that reaches the ground. The approach proposed consists of a detailed, mechanistic and physically realistic model. It employs elements of spray combustion modeling whereby droplets are divided into representative groups and these groups are tracked as they are heated, evaporate, breakup, and move under the influence of gravity and local winds. This is a well established and successful approach that can be easily adapted for fuel droplets falling through the atmosphere. In order to keep the model run time short enough to make this approach feasible for a microcomputer, only a small portion of the jettisoned fuel will be modeled in detail. The final disposition of the remainder of the jettisoned fuel can be inferred from the trajectories and impact points of the fuel that is tracked in detail. This is made possible by dividing the flight path during dumping into segments during which the forces acting on the fuel droplets do not vary with dump location. One of the major obstacles to this approach (or any other realistic approach) to this model is the inability to predict the initial droplet size distribution. While some excellent data is available, it is limited to only a few conditions of interest, and there is little basis for extrapolating this data to other aircraft, flight profiles, fuels, etc. The solution to this problem proposed herein is to employ basic research atomization data to provide best estimates of the effect of untested variables on the initial droplet size distribution.

Topic#: 92-009

ID#: 92CEL-084

Office: AFCESA

Contract #: F08635 92 C0069

PI: ALLAN J. FERRENBURG

THE TRAVERSE GROUP, INC.

2525 AERO PARK DRIVE

TRAVERSE CITY, MI 49684

Phone: (313) 747-9300

Title: Air Sparging Interdiction Field for In Situ Containment and Treatment of Contaminated Groundwater

Abstract: Accepted pump and treat technologies can be costly due to protracted lengths of contaminated groundwater cleanup projects. Present practices utilizing recirculating nutrient and oxygen-amended water have resulted in aquifer fouling due to mineral precipitation or biomass accumulation. The goal of this proposal is to develop an in situ method to contain and treat contaminated groundwater. Air sparging can be used to meet this goal. Mass transfer processes have been utilized in remedial technologies such as air stripping and vacuum extraction. An air sparging interdiction field also utilizes the mass transfer processes, which can then be coupled with in situ bioremediation. To further develop the use of air sparging to contain and treat contaminated groundwater, a series of air sparging studies in a five by four by three-foot plexiglass trough are proposed. The trough will be filled with uniform beach sand and saturated with a toluene-contaminated water source. These studies, performed at three groundwater velocities, will be used to determine the air-to-water flow rate required to strip the contaminants and to determine the amount of oxygen transferred to the water. The oxygen uptake values will be used in a computer model simulation of biodegradation potential.

Topic#: 92-008

ID#: 92CEL-055

Office: AFCESA

Contract #: F08635-92C0064

PI: JOHN M. ARMSTRONG

## AIR FORCE SBIR PHASE I AWARDS

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ALBUQUERQUE, NM 87109  
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Topic#: 92-173 ID#: 92WLO-167  
Office: WL/MNPB  
Contract #: FO8630-92-C-0035  
PI: H. M. STALLER

Title: The Development of An SCB Detonator for Fuzing, Safe, and Arm Systems

Abstract: The SCB detonator has shown significant improvements in narrowing the "all-fire/no fire" band and in decreasing function action time. Weapons implementation has been inhibited by lack of experience with this new technology and several materials problems. A need exists to resolve these problems; demonstrate the capability of the SCB to detonate DXW-I; and develop concepts for weapon systems applications. The proposed program is a joint venture between TPL, Inc. and SCB Technologies, Inc. TPL is active in the applications of energetic materials, specifically in the design and development of new primers and igniter concepts for advanced weapon systems. SCB Technologies, Inc. holds the exclusive license on the SCB technology for commercial applications from sandia national laboratories and is continuing the development of the SCB technology and formulating new scb chip designs for a range of applications. State-of-the-art SCB chips and DXW-I explosive will be procured for evaluation. The ability of the scb device to detonate dxw-1 will be demonstrated. All-fire/no-fire levels with DXW-I will be established. An SCB design with a 1 amp, 1 watt no-fire capability for DXW-I will be developed. A new header design, compatible with DXW-I, and with improved lead attachment will be fabricated. Weapon system applications will be defined and SCB requirements determined. Specific scb detonator designs will be formulated for one or more applications. TPL and SCB Technologies will be supported by the center for explosives technology research, new mexico tech. and the center for high technology materials, university of new mexico.

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Topic#: 92-127 ID#: 92WLS-107  
Office: WL  
Contract #: F33615-92C-5939  
PI: ROBERT E. MARINGER

Title: Melt Extraction of Oxide Fiber Reinforcements for High Temperature Intermetallic Composites

Abstract: This work will seek to demonstrate the melt extraction process for the formation of a continuous oxide fiber reinforcement for intermetallic composites. Alumina-YAG eutectic, which has demonstrated chemical resistance in TiAl, has an attractively high coefficient of thermal expansion (CTE), good fracture toughness and creep resistance, has not been produced by melt extraction. Building on experience in melt extraction of alumina the conditions required for formation of continuous lengths of fiber by an optimum heating method will be determined. Fiber will be characterized by optical and electron microscopy, metallography, and mechanical tests for tensile strength and modulus. Heat treatments will be performed to develop useful microstructures. The fiber properties will be correlated with processing parameters to recommend an approach for further investigation.

UBC, INC.  
8405-A BENJAMIN RD.  
TAMPA, FL 33634  
Phone: (813) 884-6076

Topic#: 92-157 ID#: 92WLO-127  
Office: WL/MNPB  
Contract #: FO8630-92-C-0022  
PI: PATRICK E. CRANE

Title: A MMW Polarization Diverse Transceiver System Providing Base Band Four Plane Monopulse, Dynamically Adjustable Nulls & Polarization

Abstract: UBC, Inc., an engineering firm performing research, development, and limited production of advanced technology over the entire electromagnetic spectrum, specializing in millimeter wave and infrared sensors, proposes an SBIR program to provide design, supporting analysis and brass-board development leading to a w-band polarization diverse four plane monopulse radar with dynamically adjustable polarization and null planes. The proposed program builds on hardware already developed by UBC, Inc. In support terminal homing seekers for air to ground application. Additions to the existing technology provide for base band angle and polarization processing as well as preprocessing transmit receive isolation of 60 dB with post processing isolation of arbitrarily high levels when combined with signal processing techniques currently being developed by the Air Force. The near term benefit to the us government is large in that monopulse radars and trackers can be made higher performance, more versatile and cost effective in "one fell swoop". The proposed approach eliminates all RF receive hardware while adding polarization diversity and adaptive nulling to nww radar at a reduction in cost. Phase I will provide component prove out, while Phase II will provide a full up sensor for integration with Air Force processing the proposed technique provides full MMIC



## AIR FORCE SBIR PHASE I AWARDS

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compatibility.

UDELL TECHNOLOGIES, INC.  
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Phone: (510) 653-9477

Topic#: 92-006 ID#: 92CEL-016  
Office: AFCEA  
Contract #: F08635-92-C0068  
PI: LLOYD D. STEWART

Title: In Situ Aquifer Restoration from Dense Solvent Contamination by Steam Injection

Abstract: Steam injection is proposed as a technology which can enhance the application of the pump-and-treat, soil venting, and bioremediation technologies in the cleanup of aquifers contaminated by dense solvents. The use of steam injection to remediate vadose zone contamination has been field-tested successfully. Aquifer cleanup is conceptually viable but remains unproven. In a conceptual cleanup, vertical steam injection wells surround the region of contamination and extraction wells are placed within this region. Steam is injected both above and below the water table. The steam injection pressure must be higher than the hydraulic pressure of the aquifer to enable injection. In the extraction wells, groundwater and product are removed and a vacuum is applied. This aids in directing the steam toward the extraction wells. The soil is heated as the steam condenses until it reaches steam temperature creating a steam zone. This steam zone grows toward the extraction wells and pushes much of the contaminant ahead of it. In the steam zone, the residual contaminant is volatilized at the elevated temperature and swept toward the extraction well by the flowing steam. After steam breaks through in the extraction wells, the injection continues until recovery of contaminants diminishes.

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COLTS NECK, NJ 07722  
Phone: (908) 946-0779

Topic#: 92-033 ID#: 92ES2-080  
Office: ESD  
Contract #: F19628-92-C-0148  
PI: ARVIND GOEL

Title: A Centralized Fault Diagnosis and Correction System

Abstract: A centralized fault diagnosis and correction (CFD&C) system has the basic requirements of monitoring the health of the target system, detecting and diagnosing anomalies and recovering from the anomalies. This proposal describes the design of a CFD&C which will have the capability to perform on-line diagnostics and correction from a central location within a multi-node configuration of elements. The CFD&C will be designed to be flexible, dynamic, and adaptive. Issues such as data management, performance, and user interface design have also been addressed in the proposal. Expert system techniques may be utilized, but the techniques will have to be extended with features necessary for a real-time environment. Methods for collecting data, techniques for detecting anomalies and strategies for recovering from anomalies exist, but the relationship between acquired data and system anomalies do not exist. Techniques that determine the relationship between the data collected, anomalies that occur and control procedures necessary to recover from the anomalies will also be designed. The prototype design of the CFD&C will be based on the open system architecture standards and will be designed on top of the unix operating system. The use of high-powered workstations, such as the 700 series workstations from Hewlett-Packard and the Sun Sparc 2 workstations from Sun Microsystems with enough mips available during the Phase II implementation will also be researched.

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CHRISTIANSBURG, VA 24073  
Phone: (703) 951-4004

Topic#: 92-004 ID#: 92AED-030  
Office: AEDC  
Contract #:  
PI: JONATHAN M. HAGER

Title: Heat Flux Calibration System

Abstract: VateLL will explore system concepts for performing heat flux calibrations at temperatures up to 1,500 degrees F and flux levels of up to 1.0 00 btu/sqft-sec. Three designs will be studied; 1) a concentrated high-intensity light system, 2) a heated graphite block system, and 3) a convection system. Each will be analyzed and modeled by finite element techniques. Possible methods for separating radiation and convection heat flux will be explored. Standards for heat flux usable with the proposed calibration systems will be developed. The cost and time to develop each system will be estimated. A final report containing all data and a recommendation for the system to be developed in a Phase II continuation will be written and submitted to the sponsor.

## AIR FORCE SBIR PHASE I AWARDS

VIGYAN, INC.  
30 RESEARCH DRIVE  
HAMPTON, VA 23666  
Phone: (804) 865-1400

Topic#: 92-122 ID#: 92WLA-023  
Office: WL/FIOP  
Contract #: F33615-92C-3003  
PI: DHANVADA M. RAO

Title: Mechanical and Pneumatic High-Alpha Vortex Control Techniques for Low Observable Forebody Configurations  
Abstract: A control vortex concept for generating high-alpha yaw and pitch control on low-observables type forebodies (viz., having diamond-shaped chined cross sections), is proposed for exploratory low-speed wind tunnel study. Two parallel approaches for realizing the control concept will be evaluated on a generic forebody configuration: a mechanically actuated vortex flap and a novel slot-blowing technique. Six-component force/moment data will be acquired with emphasis on the high-alpha regime and including large side-slip angles, to identify key variables governing the efficacy of the two techniques; complimentary flow visualizations will also be performed.

VISIDYNE, INC.  
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Topic#: 92-081 ID#: 92PL4-030  
Office: PL/OLAA  
Contract #: F19628-92-C-0098  
PI: OTT SHEPARD

Title: Lidar Detection of Space Debris

Abstract: It has been recognized by both the Air Force and nasa that space debris in the growing hazard to space operations. Of particular importance are debris in the 0.1 - 10 cm size range. Over this range, debris databases (and consequently debris models) are deficient. Also, these particle sizes are important because of their potential for damaging spacecraft. The objective of the proposed Phase I effort is to explore the feasibility of developing a lidar system to characterize space debris. Particular, but not exclusive, attention will be given to detection of debris in the 0.1 -10 Cm range. The challenge in designing a system to characterize space debris is the wide dynamic range over which the system must operate. The system must sample a large volume of space in order to detect the rare large debris particles. Simultaneously, the system must maintain enough sensitivity to detect the more numerous, debris particles. The proposed Phase I effort will compare a variety of measurement systems. A recommendation will be made based upon system performance, including minimum detectable particle size, particle detection rate, characterization of the debris, engineering feasibility, and suitability for spaceflight. Issues related to the orbital operation of the instrument will be addressed.

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Topic#: 92-083 ID#: 92PL4-032  
Office: PL/OLAA  
Contract #: F19628-92-C-0098  
PI: ORR SHEPHERD

Title: Targeting/Tracking Lidar Systems

Abstract: It is proposed to develop an innovative targeting/tracking lidar system which will have the capability of acquiring, imaging and tracking designed targets and backgrounds. The lidar system will be able to operate over multiple wavelengths and have the capability for polarization analysis of the backscatter data. The ability to acquire real-time, range resolved polarization analysis of atmospheric backscatter at multiple wavelengths with correlated ir imagery will proved a unique atmospheric database. This data can be used to support existing U.S. Air Force atmospheric models for aerosols, clouds backgrounds and spatial structures. For Phase I it is proposed to develop a set of engineering specifications and a preliminary design for the targeting/tracking lidar system. These specifications will be the basis for the Phase II development. For these specifications, trade-off availability, technical risk, and cost for each subsystem. Subsystems to be evaluated and specified include laser transmitter, imaging system, receiver and polarization optics, detection system tracking system, data system and system physical configuration.

VOSS SCIENTIFIC  
416 WASHINGTON ST. SE  
ALBUQUERQUE, NM 87108  
Phone: (505) 255-4201

Topic#: 92-061 ID#: 92PL2-052  
Office: PL/XPPP  
Contract #: F29601-92-C-0028  
PI: DR. ROBERT A. KOSLOVER

Title: Expert System for Design of High-Gain, High-Power, Fast-Risetime, Ultra-Wideband Antennas

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**Abstract:** Design of high gain ( $> 10$  db) antennas suitable for radiating multi-gw, fast-risetime ( $< 1$  ns), ultra-wideband (UWB) signals is unusually challenging. Physical laws impose some limitation, but the greater problem is the lack of widely-known practical design techniques, which are a prerequisite for effective cold-testing. Recent research has yielded improved computer codes, but these only analyze designs; they do not create them. For example, three-dimensional time-domain codes can compute performance of virtually any kind of antenna with a well-defined geometry and driving signal. However, they do not address the far more important inverse problem; computing the specific design parameters necessary to yield the desired performance. Without practical tools, the design of fast-risetime, high-gain, high-power UWB antennas is a needlessly time-consuming, expensive, high-risk guessing game. The solution proposed will provide scientists and engineers with a unique pc-based antenna design tool. This novel new tool will combine a knowledge-based expert system with customized computational programs, all operating in the user-friendly Microsoft Windows environment. Also, for the first time ever, practical equations, relations, and rules-of-thumb will be made available to designers of fast-risetime, high-gain, high-power UWB antennas.

WAMAX, INC.  
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BELLEVUE, WA 98006  
Phone: (206) 643-4755

Topic#: 92-133 ID#: 92WL5-104  
Office: WL/MLIP  
Contract #: F33615-92-C-5954  
PI: DR. RONG WANG

Title: Development of Nonchemical Processes for Adhesive Bonding

**Abstract:** Current treatments of metal surfaces for adhesive bonding are primarily based on chemical processes. The main problem of chemical processes is the use of toxic or hazardous materials, such as strong acids, volatile chemicals and chromates. Another problem is related to the low thermal stability of the adhesive bond due to formation of hydrates in the chemically grown oxide films. This work will develop novel nonchemical processes for surface treatment of titanium (6al4v), copper and aluminum (2024 and 7075) alloys. Phase I work will demonstrate specific physical processes that could yield excellent adhesive bond strength and thermal stability for titanium and aluminum. Phase II will involve optimization of the processes developed in terms of speed, uniformity and cost effectiveness of surface preparation in Phase I to titanium, copper, and other aluminum alloys. Phase III will involve commercialization of the treatments developed to replace existing chemical base processing.

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4954 SILVER ARROW DRIVE  
DAYTON, OH 45424  
Phone: (513) 233-5108

Topic#: 92-153 ID#: 92XRX-038  
Office: ASD/XRX  
Contract #:  
PI: WILLIAM R. WILLIAMSON

Title: Mission Area Planning

**Abstract:** This research will develop an extensive set of quality metrics for the evaluation of IDEF(O) model quality, in particular, and for the evaluation of systems analysis model quality, in general. The research is the continuation of investigations already performed by the principal investigator, Mr. William R. Williamson, under internal company funding and under contract F33657-91-C-2148. The specific methodology, IDEF(O), was chosen for the research because of its direct applicability to mission area planning. IDEF(O) is the most widely used methodology within the DOD for concept definition and for requirements analysis and specification. The key product of this research is a set of quality metrics which goes far beyond editing considerations such as labeling, drafting, and compliance with modeling rules. The metrics will evaluate model decomposition quality, precedence relationships, constraint vs flow conflicts, generic vs specific content, and model complexity. The research products will be specific and generic quality metrics, methodology formalization enhancements, identification of machine-detectable quality factors, algorithm definition for whole diagram and whole model quality evaluation, and training materials.

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154 FAIRBANKS PLAZA  
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Phone: (615) 481-0572

Topic#: 92-002 ID#: 92AED-023  
Office: AEDC  
Contract #:  
PI: JAMES R. STEVENSON

Title: Electron Beam Heated Cryogenic Infrared Source Array

**Abstract:** The current generations of long wavelength infrared focal plane array based sensor systems require complex, dynamic imagery for performance testing. We propose to design a target array held at cryogenic temperature with the array elements

## AIR FORCE SBIR PHASE I AWARDS

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heated by an electron beam. Proper design of the array target will allow complex thermal imagery to be generated from either computer graphics or stored and processed video images. By designing the array to properly manage the heat transfer out of the array elements, dynamic changes in the target image can be realized.

WIZDOM SYSTEMS, INC.  
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NAPERVILLE, IL 60563  
Phone: (708) 357-3000

Topic#: 92-030 ID#: 92AL -213  
Office: AL  
Contract #: F41624-92-C-5002  
PI: ALLEN W. BATTEAU

Title: Frame/Work: Human Issues In CALS Implementation

Abstract: This research develops a framework for identifying the critical structural and environmental factors affecting the implementation of CALS technologies at SPOS and ALCS. It combines a bottom-up view of the environmental factors affecting work groups' acceptance or rejection of those technologies with a top-down model of the structural factors determining the work groups' environments. This combination of top-down and bottom-up approaches permits the creation of a set of culturally appropriate diagnostic and intervention tools for facilitating the insertion of CALS technologies at SPOS and ALCS.

XAR INDUSTRIES, INC.  
151 PUENTE AVENUE  
CITY OF INDUSTRY, CA 91746  
Phone: (818) 333-3878

Topic#: 92-155 ID#: 92XRX-019  
Office: ASD/XRX  
Contract #:  
PI: THOMAS P. TARQUINO

Title: Automatic Probe Seeking Aerial Refueling Drogue

Abstract: XAR and its subcontractor dataproducts new england (DNE) have reviewed previous flyable drogues reports. Using present techniques, a design layout for a flyable drogue will be generated. The layout will be continually updated during the course of the research. After reviewing available homing principles such as acoustic, differential pressure, magnetic, electromagnetic, including light, an appropriate control system will be designed. The required forces and moments, will be studied parametrically as a function of hose length and desired drag. Damping of the drogue as a function of controls on and off will be studied. Effects of altitude on controllability will be studied. Required energy to affect control will be studied. The goal of this research will be to discover what combination of achievable characteristics will lead to a conceptual design that will satisfy the problem statement by the Air Force. The final report will include a detailed layout of the drogue design along with discussion of the design's predicted performance. Preliminary work done by dne in the mid-eighties suggests a drogue whose symmetrical control surfaces are located in the approximate space of the present paradrogue spokes, will be capable of stowage in existing hose reel tubes and can provide useful performance.

XMCO, INC.  
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Topic#: 92-036 ID#: 92ES2-116  
Office: ESD  
Contract #: F19628-92-C-0154  
PI: CHARLES G. GARVEY

Title: LSA software Supportability Integration

Abstract: XMCO Inc. proposes to integrate software supportability requirements as outlined in military standards such as 2167a into the LSA process as outlined in MIL-STD-1388-1A that is presently oriented toward hardware. The specific objectives of the Phase I effort are: a. Objective 1. Identify all supportability software tasks and subtasks that must be integrated into MIL-STD-1388-1A to ensure a comprehensive document for systems acquisition, b. Objective 2. Determine the specific locations within c. Objective 3. Develop the four part (purpose, description, input, and output) task statements for each software supportability requirement, and d. Objective 4. Prepare an implementation /demonstration plan to include software data in MIL-STD-1388-1A, prepare the task statements required, and develop a plan for integration of MIL-STD-1388-1A data into MIL-STD-1388-2B LSA. Xmco possesses a blend of personnel expertise and contract experience on both ILS and software development that will result in the professional conduct of this program.

AIR FORCE SBIR PHASE I AWARDS

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XONTECH, INC.  
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LOS ANGELES, CA 90045  
Phone: (310) 649-3477

Topic#: 92-092 ID#: 92PL6-092  
Office: BMO/MYSP  
Contract #:  
PI: KURT E. GOLDEN

Title: Electromagnetic Transmission Through Plasma, Adding GPS To Inertial Platform

Abstract: Combining GPS and inertial navigation systems on future advanced hypersonic aerodynamic weapon systems could provide superior navigation performance compared with current inertial platforms along and at a lower cost. GPS solutions along would be difficult because of plasma sheathing periods starting above 150 kft and lasting until the vehicle velocity falls below 15 kft/second or lower. The inertial measurement unit (IMU) would provide navigation solutions during this GPS coast phase. The addition of GPS could result in reduced performance requirements on the IMU. Plasma sheathing issues on GPS performance are addressed including reduction of signal strength, increased system noise temperature caused by plasma and antenna windows, and antenna coverage changes. Plasma diagnostics and plasma alleviation are examined for future flight testing of the concept.

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WYNDMOOR, PA 19118  
Phone: (215) 576-5566

Topic#: 92-047 ID#: 92ES3-095  
Office: RL  
Contract #: F19628-92-C-0130  
PI: BURTON S. ABRAMS

Title: Antimultipath System for Measurement of Ultralow Sidelobe Antenna Patterns

Abstract: A novel technique is proposed which will allow the resolution, analysis, and suppression of the multipath components of an antenna range measurement test signal. The technique achieves time delay resolution much finer than the reciprocal of the bandwidth of the test signal. As a result, ultra low sidelobe antenna measurements can be made in real time without using an ultra wideband test signal and without corruption by unavoidable multipath artifacts on the antenna test range. Computer programs that simulate the operation of this new multipath suppression technique will be used to optimize the system parameters for operation at the specified measurement speed and accuracy. This will provide a demonstration of feasibility and will allow the design definition of a hardware prototype to be formulated. The parameters of the prototype hardware system will be optimized for the accurate real time measurement of ultra low sidelobes and nulls of a modern antenna array.

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